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F.S. Publication 120.

ROYAL AIR FORCE.

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HANDBOOK  
ON THE  
VICKERS GUN.

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N.B.—Heavy type applies to GROUND GUN only.

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*Issued 1919.*

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AIR MINISTRY,

May, 1919.



## PREFATORY NOTE.

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There has not hitherto been a comprehensive handbook on the Vickers Gun for use in the Royal Air Force. The volume of "Instructional Notes" issued by the General Staff in January, 1918, was designed for teaching purposes, and, although it fulfilled that aim quite satisfactorily, it was not sufficiently full to serve as a complete handbook on the gun. In view of the fact that it is undesirable and unnecessary to have two different books dealing with the subject from the Royal Air Force point of view, the present pamphlet has been compiled, the object being to set down in convenient form all necessary matter in connection with the gun, and at the same time to incorporate the instructional methods by which that matter can be most quickly and effectively taught to pupils. It is hoped that the resulting book will form an adequate guide to the Vickers Gun for all members of the Royal Air Force.

## CONTENTS.

<i>Section.</i>	<i>Page</i>
I. General Description .. .. .	
II. Drill .. .. .	
III. Stripping .. .. .	
IV. Mechanism .. .. .	
V. Care and Cleaning .. .. .	
VI. Immediate Action .. .. .	
VII. Causes of Stoppages and Setting-up Gun for Instructional Purposes .. .. .	
VIII. Points Before, During, and After Flight (or Range Practices) .. .. .	
IX. Examination of Gun .. .. .	
X. Minor Repairs and Adjustments .. .. .	
XI. Spare Parts .. .. .	
XII. The Testing of Ammunition .. .. .	
XIII. Electrical Heaters .. .. .	
XIV. List of Component Parts of the Gun .. .. .	
XV. Tuning up of Guns .. .. .	
XVI. Rounds Counter.. .. .	



## ILLUSTRATIONS.

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(List to be supplied later.      Room should be left)

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LIST OF GUNNERY HANDBOOKS.

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*Subject.*

*F.S. Pub. No.*



# HANDBOOK ON THE VICKERS GUN.

## I. GENERAL DESCRIPTION.

### *Weight :*

**Ground gun (Mark I.) about  $28\frac{1}{2}$  lbs. with casing empty.  
about  $38\frac{1}{2}$  lbs. with water in casing.**

**Aerial gun (Mark II.) about  $28\frac{1}{2}$  lbs.**

*Note.*—Guns manufactured during the war had a number of refinements omitted, and are about 4 lbs. heavier.

### *Method of operation :*

The gun is worked automatically by two forces :

1. The action of the gas generated by the explosion of the charge ;
2. The fusee spring.

### *Cooling system :*

**The ground gun is cooled by water which is placed in the barrel casing, the barrel itself being constantly surrounded by the cooling medium.**

The aerial gun is cooled by air, the front and sides of the barrel casing being cut away to allow a stream of air to be driven along the exterior of the barrel by reason of the rapid flight of the aeroplane.

## General Description of Parts.

The gun is divided into two portions :—

- (1) The non-recoiling portions ;
- (2) The recoiling portions.

### Non-recoiling Portions.

These consist of :—

- (a) The *Barrel Casing* (including the gland and the outer casing of the muzzle attachment) ;
- (b) The *Breech Casing*.

#### (a) *Barrel Casing.*

This is made of steel, and has longitudinal corrugations for the purpose of strengthening it.

- (i.) *Exterior.*—On the front end of the casing is fitted the *Muzzle Attachment* which consists of two portions, the *Muzzle Attachment Outer Casing* (including the *Front Cone*) and the *Gland*.



The muzzle attachment outer casing is a hollow cylinder threaded internally at its front end to receive the front cone. Behind this portion are six vent holes for the escape of gas. Immediately behind is a threaded hole to take the stud to which is attached the chain carrying the split pin by which the muzzle attachment outer casing and the gland are locked together. Internally, at the rear end, are three rectangular projecting portions which form an interrupted flange for connection with the gland, one of these projections having a small stop. At the centre of each of these projections the outer casing is bored to accommodate the split pin mentioned above. The front cone (Mark II. pattern) is of very substantial construction in order to make it bullet-proof. It is also conical in front so that bullets striking it may be deflected. At the rear of this portion are four serrations on its outer circumference for fixing and removing it. Behind these the diameter is slightly smaller and is threaded to screw into the muzzle attachment outer casing. Behind this the diameter is again slightly smaller and plain. This portion accommodates the rim of the disc. The rear of the cone is bevelled outwards, and then coned inwards, these surfaces being protected by a thin *Disc* of similar shape, so that the cone itself is not eroded by the gases. The cone is bored longitudinally to allow the bullets to pass through it. The gland is circular and hollow. At its front it has three exterior projections which form an interrupted flange corresponding to that on the muzzle attachment outer casing. Beyond these are three holes to take the split pin which locks the gland and the muzzle attachment outer casing together. Immediately behind, on a projecting rim, are four serrations for fixing and removing the part. At the centre of the rear face is a circular projection bored to accommodate the barrel, and threaded externally to screw into the front end of the barrel casing.

**At the top of the front face of the barrel casing is a hole to accommodate the screwed head of the steam tube, beside it being a small threaded hole which takes the keeper screw.**

For the first two inches of its length, the barrel casing is plain. On the under side of this portion are two holes. **The one on the right is the Emptying Hole, which is threaded internally to take the Screwed Plug that closes it. The hole on the left communicates with the Steam Escape Tube, and is continued into a projection closed by a Cork Plug. Both these plugs are secured by Safety Chains.** At the rear end of the corrugations the barrel casing has another plain surface, **at the top of which is the Filling Hole, threaded internally to take the Screwed Plug by which it is closed. (NOTE : This hole is placed slightly to the right in order to prevent the casing from being completely filled, as this might lead to damage during frosty weather, and also to prevent the steam tube from being fouled by the funnel while the casing is being filled).** On the under side of the rear plain portion is a *Bracket* by which the gun is attached to the mounting. Beyond the circular part, the barrel casing is continued at the bottom and towards the rear of the gun. The front end of this continuation forms a *Sleeve* which acts as a bearing for the barrel. Behind this it takes the form of a *Bottom Plate*. This is cut away at the rear end,



and strengthened at its edge to serve as a *Seating for Ejection*, while the small portions remaining on each side act as bearing surfaces for the front end of the side plates.

In the aerial gun the barrel casing is cut away at the front, and *Leaves* are made at the rear end of the corrugated portion.

(ii.) *Interior*.—The inside of the barrel casing is tinned, to prevent rust. At the front end is the *Barrel Guide*. This consists of a vertical portion, bored centrally to admit the barrel, and a curved sloping part below to guide the barrel into the hole during the process of assembling. Between the front of the barrel guide and the rear projection on the gland is a small chamber which accommodates the asbestos packing wound on the barrel. Extending backwards to the rear end of the circular portion of the barrel casing is a brass trough which leads to the sloping part of the barrel guide and prevents the tinned surface of the casing being scratched off while the barrel is being assembled.

The *Steam Tube* is made of brass and consists of two tubes. The longer and inner tube runs the whole length of the circular part of the barrel casing. Its rear end is conical and fits into a thimble fixed on the inside of the breech end of the barrel casing. At its front end is a threaded head which screws into the muzzle end of the casing. Near each end of the tube is an entrance hole for steam. In the screwed head is a third hole through which the steam passes to the steam escape tube, the latter being fixed to the inside of the barrel casing. The screwed head is positioned by a keeper screw which ensures that the steam entrance holes are at the top of the tube, and that the third hole is opposite to the steam escape tube. The shorter and outer tube is free to move along the inner tube and is of such length that the steam entrance holes are never both covered at the same time. It thus forms a *Sliding Valve*. This device allows the steam to escape, while the water is retained.

(b) *Breech Casing*.

(i.) *Right and Left Outside Plates*.—These extend from the circular portion of the barrel casing to the rear of the gun. At the front end they are riveted, for about six inches, to the extension of the barrel casing. At the top there is in each case a hole for the front cover catch. Just behind, both plates are cut away at the top to accommodate the feed block. Immediately behind this cut-away portion there is on each plate a projection, bored to take the joint cover pin. Along the upper edges both plates carry flanges which fit into grooves on the rear cover, thus ensuring stability. At the rear end the plates have rectangular slots in which the crank bearings move, these slots being partially closed by the *Right Slide* and the *Left Slide*. Above the slotted portion each plate has a hole to accommodate the T-fixing pin. At the bottom in each case is another hole which takes the rear crosspiece axis pin, the corners of the plates being here rounded to give clearance for the movement of the rear crosspiece. At the rear of the plates are two projections which fit into slots in the rear crosspiece. On the under side of each plate is a lug bored centrally, these lugs forming a *Bracket* by which the gun is attached to the mounting.



On the inside of each plate is a cam, by means of which the movement of the extractor is partially controlled. Near the rear end of these cams, and on the top sloping surface, a step is cut, so that the lock may be hindered from going forward if the recoil action is insufficient. These steps also enable the lock to be "hung."

(ii.) The details given above are common to both plates. Peculiar features possessed by either are as follows:—Right outside plate (exterior). Rather more than halfway along there is the *Check Lever Bracket*, which is a cut-away rectangular plate riveted in position. Fastened to this bracket is a stud on which the *Check Lever* is pivoted, and to which it is secured by a small keeper pin. The check lever is cut away to receive the end of the crank handle when the gun is in the firing position. The right slide carries the *Roller*, this being held in position by a *Collar* and *Split Pin*.

Left outside plate (exterior). Near the front end and at the top is a stop which limits the movement of the lever of the front cover catch, the plunger of the latter being accommodated by a groove in the stop. Immediately behind and below are two studs for holding the front end of the fusee spring box. Longitudinally the plate is milled out (ribs being left for strengthening purposes). **Rather more than half-way along, and at the bottom, is the *Elevating Stop*, which protects the fusee spring box from damage when the gun is on a tripod mounting.** The left slide carries a stud which forms the back anchorage for the fusee spring box.

(iii.) *Front Cover*. This closes the top of the recess which accommodates the feed block. At its front end, on the lower side, is riveted a plate carrying the *Hooks* by which it is secured. Behind this its lower surface is milled out almost to the rear, a rim being left to fit inside the flanges on the feed block. For a short distance, at the front, this rim is milled externally to give a grip when the cover is raised. At the rear end, on the underside, is a projection forming the *Extractor Stop*. Where the front cover is hinged to the rear cover, it has an enlarged portion, cut away in the middle, and bored to accommodate the *Joint Cover Pin*.

The *Front Cover Catch* extends from the right to the left outer side plates, and comprises a cylinder having two flats cut into it. On the left is the *Front Cover Catch Lever*, which is in the shape of a handle, the horizontal arm being hollowed out to contain the *Front Cover Catch Plunger, Spring* and *Plug*. When the lever is turned up, the front cover hooks are in line with the flats on the front cover catch, and the cover may be raised. When the lever is lowered, the front cover hooks are retained by the circular portion of the catch. The outer end of the lever is milled, to form a finger-grip. The catch is bored near the left end to receive a split pin which prevents its withdrawal from the gun.

(iv.) *Rear Cover*. At the front end of the rear cover is an enlarged portion cut away on each side and bored to admit the joint cover pin. On the under side are grooves, on the extreme right and left, to accommodate the flanges on the outer side plates. The under side is milled out into three channels, **the centre one of which accommodates the trigger bar**, the ribs on either side forming guides for the top of the



lock. In the side channels are riveted the *Ramps*, which are, roughly speaking, triangular in shape, the longest side being curved. On the sides of the centre channel are three pairs of small projections by which the trigger bar is retained in position. The *Trigger Bar* has on either side, from front to rear, a rim which is held by these projections. At its front end the trigger bar is slotted for nearly half its length. Near the rear end it has on the right a projection which serves as a seating for the *Trigger Bar Spring*, the spring itself being spiral and contained in a tunnelled projection at the rear of the right channel. The extreme rear of the trigger bar has a small portion turned downwards for the action of the trigger bar lever.

At the rear of the cover are two cut-away projections bored to accommodate the *Rear Cover Lock Axis Pin*. The *Rear Cover Lock*, which pivots on this pin, is right-angled in shape, and consists of a small semi-circular plate with three projections. Two of these are in the form of hooks which engage in recesses in the rear crosspiece. The third is a lug on which the rear cover lock spring acts. The curved plate extends behind the breech casing and serves as a thumb-piece for lifting the cover. The movement of the rear cover lock is limited by two small lugs, one on each side, which engage in recesses in the projections at the rear of the cover itself. **On the under side of the lock is a recess which gives clearance for the movement of the fore part of the safety catch.** The rear cover lock is normally held down by the action of the *Rear Cover Lock Spring*, which is flat and lies on the left channel on the under side of the cover. The front end of this spring is slotted to fit under a T-shaped stud which serves it as a seating. The rear end of the spring presses on the lug on the cover lock as already described.

(v.) *Rear Crosspiece*.—This comprises a plate which closes the breech end of the gun. On its inner side, to right and left, are ribs forming two grooves which accommodate the rear edges of the outer side plates. At two points on each side these ribs have enlarged portions bored to receive respectively the T-fixing pin and the *Rear Crosspiece Axis Pin*. On the inner side of the upper pair of these projections are small curved seatings for the horizontal arms of the trigger bar lever. At the bottom, joining the lower pair of projections, is a horizontal plate which, when in its normal position, forms a part of the bottom plate of the breech casing. At the top, on the left, the inner side of the plate is bevelled to give clearance for the movement of the rear cover lock spring. In the middle, near the top, are three holes, **the centre one being circular to admit the safety catch piston and spring**, while those to right and left are rectangular and provide a grip for the hooks of the rear cover lock. **Below, and in the middle, is another rectangular hole which admits the pawl on the firing lever.** The rear face of the plate of the crosspiece has two pairs of projections bored to accommodate respectively the safety catch axis pin and the firing lever axis pin. At the top the plate is bevelled to right and left for the guidance of the hooks on the rear cover lock. **In the middle of the plate is a vertical recess which admits the lug on the safety catch.** On either side of this recess, at the extreme right and left, are rectangular slots which receive the rear projections on the outer



side plates. Extending from the corners of the plate are brackets, to which are fitted the *Traversing Handles*.\* These handles are hollow steel cylinders covered with wood. They form small reservoirs for oil, and are closed by milled plugs which screw into the cylinders and carry camel hair brushes on the under side.

*Trigger Bar Lever*.—This is cruciform in shape. At the top it is flattened to fit closely the rear end of the trigger bar. Immediately below the top, on its rear side, is a circular recess to receive the safety catch spring. At the bottom, on the same side, is a horizontal recess for the pawl on the firing lever. The horizontal arms of the trigger bar lever are bored to take the T-fixing pin, which acts as its axis.

*Safety Catch*.—This consists of a central part with extensions to right and left, the ends of these being flattened, enlarged and milled on the under side, to form finger grips. The central part is bored to take the *Safety Catch Axis Pin*, and has at the top a projection which limits the amount of upward movement of the safety catch. On the under side two stops are provided which control and limit the movement of the firing lever. The safety catch is normally held in the "safety" position by the *Safety Catch Piston and Spring*, the former being a small hollow cylinder with a rectangular head, while the spring is spiral.

*Firing Lever*.—At the top this is slightly cut away to fit the stops of the safety catch. On its inner side it is recessed to accommodate the *Firing Lever Pawl*. Towards its lower end it increases in thickness, and at the bottom it is bored to receive the *Firing Lever Axis Pin*. At its lower extremity, on the inner side, is a flattened portion which acts as a stop. Extending to the rear, at the top, is the *Firing Lever Thumbpiece*, which is T-shaped and has a curved flat plate milled on the outer side. The firing lever pawl is wedge-shaped and bored to accommodate the axis pin on which it is pivoted.

*T-Fixing Pin*. This, as the name indicates, is T-shaped. The longer arm is threaded externally at the end to screw into the flange on the right of the rear crosspiece. Near the other end of this arm is a collar which positions it on the flange on the left side of the rear crosspiece. The head of the T-fixing pin is of two different diameters, the smaller of which enables it to be used to push out the split pin from the side levers axis bush when the lock is being stripped. For this purpose the extremity of this arm is slightly hollowed out.

(vi.) *Bottom Plate*.—This consists of three portions, which, together with the rearward extension on the barrel casing, completely close the under side of the gun. The largest part of the bottom plate comprises a fixed portion which is cut away for about half its length in front. This aperture is closed by a sliding shutter which is accommodated in grooves on the under side of the fixed plate. At the front end of the *Sliding Shutter* is a turned-up portion which connects with the extension of the barrel casing. Below, and just behind, is a transverse tunnelled projection containing a plunger on the left and a *Sliding Shutter Catch* on the right, these two being separated by a spiral spring. The plunger limits the forward movement of the shutter

\* The aerial gun has only one Traversing Handle, on the right.



by its contact with a raised stop on the left side of the gun. The sliding shutter catch is operated by a milled projection and a milled circular plate, these affording a grip. On its upper side is a small stud, which, under the influence of the spiral spring, engages in recesses on the right of the bottom plate at the limits of the forward and backward movement of the shutter. Behind the sliding shutter the fixed part of the bottom plate is not cut away. The aperture behind the fixed portion of the bottom plate is closed by a small plate on the rear crosspiece.

(vii.) *Feed Block* : EXTERIOR.—The feed block is made of steel or gun-metal, and fits into a recess in the outside plates of the breech casing. It is covered and held down, when in position, by the front cover. At the front is a projection bored vertically to accommodate the axis pin of the top and bottom levers. Ribs are provided for positioning the feed block in the gun. Behind the projection the feed block is milled out at the top and at the bottom, ribs being left for positioning and strengthening. Immediately to the rear of this milled portion the feed block is cut away in the middle, and has transverse grooves to accommodate the slide. On the right, opposite the cut-away portion, the upper surface of the feed block is recessed. At the rear, the upper part is milled out, ribs being left as before. The rear face is cut away to allow the cartridge to be drawn out, the part on the left of this aperture acting as a *Cartridge Stop*. There are also grooves to accommodate the ribs on the face of the extractor. At the top of the right groove, a small projection is left as a guide for the cartridge rim. INTERIOR. The feed block is hollowed out to admit the cartridges, guides being provided at front and rear to ensure that the rounds are brought to exactly the correct position. At the bottom is a rib which acts as a bearing surface for the belt as it is fed in. At the front, on the right, is a bevelled portion which serves as a guide for the noses of the bullets, while towards the left side are two projections which form the *Bullet Stop*. At the rear are two raised portions, above and below, and rounded off on the right side, which serve as guides to the rims of the cartridges. At front and rear, and slightly to the right, are slots through which the bottom pawls project into the feed block.

*Bottom Lever*.—This is right-angled in shape. The horizontal arm is flat and has on the under side a semi-circular projection which engages in the recess in the prolongation of the left side-plate. The other arm is bored to receive the split pin which secures the part to the top lever. The vertical portion of the lower lever is cylindrical, except at its upper end, where it is hexagonal.

*Top Lever*.—This is bored at its front end to fit the hexagonal part of the bottom lever. At the rear end, on the under side, is a stud which engages in the slot in the slide. The top and bottom levers are secured together by a split pin having a flat head.

*Slide*.—This moves transversely in the feed block, under the influence of the stud on the top lever, the stud being accommodated by an elongated hole bored through the slide, slightly to the left. On the under side it is for the most part milled out. On the left are two projections which form the seating for the top pawls spring. On the right are two other projections bored to receive the top pawls axis



pin. The right side of the slide has two small recesses to accommodate projections on the top pawls.

*Top Pawls.*—These are two in number. They are bored to receive the *Top Pawls Axis Pin* on which they pivot. The left extremity in each case is milled, to control the movement of the rounds more effectively. The front pawl has also an enlarged head. At the right extremity of each pawl is a small curved plate milled to form a finger-piece. On each of these finger-pieces is a small projection fitting into the slide.

*Top Pawls Spring.*—This is flat and U-shaped, and carries on the left a projection for fixing and removing it.

*Bottom Pawls.*—These are connected with each other by means of a curved milled plate, to which they are riveted, the three portions forming one U-shaped, right-angled part. The pawls are bored to admit the *Bottom Pawls Axis Pin* on which they pivot, this pin having an enlarged head at one end and a split portion at the other.

*Bottom Pawls Spring.*—This is a double spring which is retained in position by the bottom pawls axis pin.

(viii.) *Fusee, Fusee Chain, Fusee Spring and Fusee Spring Box.*

*Fusee.*—This consists of a curved portion cut away at the front to a right-angled recess which fits the links of the fusee chain. At the upper end of this part is a hole bored to admit the pin by which the fusee and the fusee chain are fastened together. At the lower end of the fusee, and on the inner side, is a stem with two lugs and two feathers which position it correctly in the crank.

*Fusee Chain.*—This consists of two links, the forward link being solid, while the other one is hollow. At the front end of the solid link are two small projections which fit into the hooks at the rear of the fusee spring.

*Fusee Spring.*—This is a strong spiral spring fastened at its front end to a circular brass plug which is bored and threaded internally to receive the adjusting screw. At the rear end of the spring is fastened an attachment which has two hooks projecting to the rear.

*Adjusting Screw.*—At the front end this is bored to admit the *Vice Pin* by which the tension of the fusee spring is adjusted. The head of the adjusting screw is retained on the outer side of the fusee spring box by the front end of the box; Behind the head of the tension screw are two small projections which fit into recesses in the front of the fusee spring box. To the rear of the head the adjusting screw is threaded externally to connect with the brass seating on the fusee spring.

*Fusee Spring Box.*—This is an elongated casing provided with two hooks at the front end and one at the rear, by means of which it is attached to the left outer side plate and the left slide. At the front end are two small recesses to accommodate the projections on the rear of the head of the adjusting screw. The upper edge of the box is slightly cut away near the front to clear the feed block. The lower edge is cut away towards the rear to clear the middle rib on the left outer side-plate.



## Recoiling Portions.

These consist of :—

- (a) *The Barrel* (together with the *Muzzle Cup*).
- (b) *The Side-plates*.
- (c) *The Crank* (including *Crank*, *Crank Handle*, and *Connecting Rod*).
- (d) *The Lock*.

(a) *Barrel*.—This is  $28\frac{1}{2}$  inches in length. At the fore end it provides accommodation for the muzzle cup. On the Mark I barrel this takes the form of a groove immediately behind the muzzle, for the clamping-screw, a flat being cut in front of the groove to allow the cup to be assembled. In the Mark II barrel the fore end is threaded to take the muzzle cup. The barrel is tapered towards the front. Near the rear end is a *Cannelure* (or groove) to accommodate asbestos packing. The part of the barrel immediately behind and before the cannellure is reinforced, and the external diameter is therefore greater. The breech end of the barrel forms a square *Barrel Block* from which the two *Barrel Trunnions* project at the sides. At the rear of the barrel are vertical grooves to accommodate the ribs on the face of the extractor. The barrel is bored longitudinally and rifled, having five grooves and lands with a left-handed twist. Above the rear end of the boring is a small cut-away portion which guides the noses of the bullets into the chamber. Inside the reinforced part at the rear, the barrel is shaped to form a *Chamber* into which the cartridge exactly fits. Immediately in front of this chamber is the *Lead*, which forms a funnel to guide the bullet into the rifling.

*Muzzle Cup*.—This consists of the cupped portion itself and stem for attachment to the barrel. It is bored from front to rear to admit the barrel, and on the outside of the stem are four serrations for fixing and removing it. In the Mark I pattern the stem is split, and bored transversely to accommodate a clamping-screw which lies in the groove on the muzzle end of the barrel. In the Mark II pattern the stem is not split, but is threaded internally in front to screw on to the barrel. Except where the conversion set is used for speeding-up the gun, a .05 steel washer should be placed between the end of the barrel and the Mark II muzzle cup.

(b) *Left and Right Side-Plates*.—For the greater part of their length both plates are milled out on the outer side. At the front end they are bored to receive the barrel trunnions. Near the front end they are fitted with *Side-Plate Springs* which ensure that the horns of the extractor do not drop below the cams on the outer side-plates during the backward movement of the lock, when there are no cartridges on the extractor. At the bottom of each side-plate is a guide, from front to rear, along which the flanges of the lock move. Each of these guides has two interruptions to enable the lock to be lifted out. Near the rear end each plate has a square reinforced portion with a circular boring which acts as a bearing for the crank. Immediately behind, both plates have extensions for the exclusion of grit from the slots



in the outer side-plates. At the front end of the left side plate is a prolongation with a recess for the engagement of the stud on the lower lever of the feed block.

(c) *Crank*.—This is cut away on both the upper and the under side (to allow for the movement of the sear and the connecting-rod respectively, during the action of the gun). At the front it is bored transversely to admit the crank pin. At the rear of the crank are circular projections to right and left, which are carried in bearings in the side-plates. The projection on the left is bored to accommodate the fusee, the feathers and lugs on the latter being received in feather-ways and a groove, so ensuring correct fit and driving action. The projection on the right carries the crank handle, for which purpose it is hexagonal in shape at the extremity. The handle is secured in position by a screwed fixing-pin.

*Connecting-Rod*.—This pivots freely upon the crank pin. At the front it is circular and fitted with three projections which secure its connection with the lock. About half-way along is an exterior thread which accommodates the *Adjusting Nut*. By this means—washers being inserted below the adjusting nut, if necessary—the position of the connecting-rod in relation to the lock is regulated, this in turn regulating the distance between the extractor and the barrel. The rear part of the connecting-rod is rounded and milled on its upper surface to provide a finger-grip.

*Crank Handle*.—This forms, roughly-speaking, a flat curve. At the front end it is fitted with a knob set horizontally and at right angles. Rather more than half-way along there is on the right side a boss bored hexagonally to fit the right extremity of the crank. On the upper side, at this point, is a shallow depression. The rear part of the crank handle is in the form of a curved, tapered *Tail*.

(d) *Lock*.—This comprises several parts, as follows:—

*Casing*.—This is cut out of solid metal. The exterior is for the most part slightly milled out, raised portions being left to form ribs along the top and front edges, flanges at the bottom, stops at the front bottom corners, and seatings for the axis pins of the tumbler and trigger and the side levers axis bush. On the face of the casing there is at the top a projection which forms an *Extractor Stop*, and which, in conjunction with the stop on the under side of the front cover, limits the upward movement of the extractor. Near the bottom the face is bored to admit the firing pin. The sides of the casing are bored to accommodate the axis bush of the side levers, the trigger axis pin and the tumbler axis pin. On the left side there are also recesses for the head of the trigger axis pin and the feather on the tumbler axis pin. Near the top rear corner the casing is bored to receive a pin and distance piece by which it is strengthened and the sides correctly positioned. At the bottom are two *Flanges* which ride on the guides of the side-plates during the movement of the lock. In the upper flanges are rectangular slots which accommodate the projections on the side levers. The lower flanges have interruptions agreeing with those in the guides on the side-plates, in order that the



lock may be lifted out of the gun. At the front end the bottom of the lock is bored to give clearance to the movement of the head of the sear.

The interior of the casing is entirely hollowed out. Behind the top of the face is riveted a piece of metal which acts as a guide for the lock-spring when the lock is being assembled, and which also forms a seating for the spring. Near the bottom are horizontal ribs from front to rear which act as guideways for the firing-pin. At the front lower corner is a pin which serves as an axis for the sear.

*Side Levers.*—These are two in number, and, together with the *Side Lever Head*, are cut out of the solid, the whole forming one Y-shaped piece. The side levers are bored and recessed at the front to accommodate the side levers axis bush. On the inner side, round this hole, there is in each case a reinforced portion which serves as a bearing and a distance piece. Immediately behind, and on the under side of the levers, are small projections which fit into slots on the lock casing. The side levers have arms projecting upwards and backwards from the front. At the top these arms are rounded off towards the rear, each curved portion being interrupted by a *Step* which engages with the bent on the extractor levers. The side lever head forms a cylindrical stem by which the lock is joined with the connecting-rod. It is bored longitudinally to admit the stem of that part, and at the front end it has on the inside three projections which engage with the three on the connecting-rod when the lock is in its normal position in the gun.

*Extractor Levers.*—These are two in number, and take the form of plates of irregular shape. When in position they pivot on the tumbler axis pin and lie close to the outside of the lock casing, the front portion being slightly set out so as to clear the ribs on the edges of the face of the casing. The upper part of the front ends is shaped so as to lift the extractor easily and continuously during its upward movement, while on the under side, and slightly to the rear, is a straight portion which bears on the stop on the side of the lock casing, so limiting the downward movement of the extractor. At the rear end, on the outer side is the *Bent*, which is acted upon by the side lever. At the rear lower corner the extractor levers are bored to receive an axis pin. The right lever is slightly chamfered to clear the small auxiliary cartridge rim guide in the right groove of the breech end of the barrel.

*Trigger.*—Above the *Nose* (or lower end) of this is a circular portion which serves as a bearing, and which is bored to receive the *Trigger Axis Pin*.

*Tumbler.*—This is curved in shape. Its *Head* is enlarged and flattened for engagement in the recess in the firing-pin. The central part is enlarged and has a circular rim bored to accommodate the *Tumbler Axis Pin*. Immediately opposite is a *Bent* in which the nose of the trigger engages under the influence of the short arm of the lock-spring. The *Tail* curves slightly downwards to the rear.

*Firing-Pin.*—This is roughly rectangular. On the upper side there is a projection at the front, against which the long arm of the lock-spring bears. Protruding from the front is the tapered portion which explodes the cartridge. Behind this the firing-pin is cut away so that the side levers axis bush (which runs through it) may not



hinder its forward and backward movement. Towards the rear, on the upper side, is a recess in which the head of the tumbler engages. On the under side, halfway along, is a bent—bevelled towards the rear—which engages with a corresponding bent on the sear.

*Sear*.—This has an enlarged head recessed to form a *Claw* which accommodates the pin inside the front lower corner of the lock casing, by which means the sear is correctly positioned. Behind, and on the under side, is a small slot which forms a seating for the flat *Sear Spring*. On the upper side is a *Bent* which engages with that on the firing-pin. The *Tail* tapers slightly and is turned down at the end.

*Lock-Spring*.—This is U-shaped. It has two arms, curved and of unequal length, the shorter of which acts on the trigger while the longer one presses on the projection at the front of the firing-pin. The ends are both slightly rounded.

*Side Levers Axis Bush*.—This is a small hollow cylinder with a rim at one end, this rim being accommodated in a recess in the side levers. Through the bush is passed the *Side Levers Axis Bush Split Pin*, which has a flat head, while its other ends are slightly thicker.

*Tumbler Axis Pin*.—This has near one end a collar bearing a feather, both being accommodated in the left side of the lock casing.

*Trigger Axis Pin*.—This has a flat head received in a recess in the left side of the lock casing.

*Extractor*.—On the front of this, at either side, are ribs, the portion immediately behind being cut away to form *Cartridge Grooves*. At the top the ribs curve forward slightly, the grooves thus being wider to ensure that the rim of the round is gripped. In the face of the extractor is a vertical slot cut to accommodate the gib. Below this is a hole to allow the front end of the tapered portion of the firing-pin to pass through. At the side of the extractor, near the top, are the projecting *Horns*, which support it on the cams during the backward movement of the lock. At the front these horns are fined down to an edge so as to avoid the risk of jamming against the edge of the cams. Below the horns the extractor is cut away on either side, *Shoulders* being left for the extractor levers to bear upon when lifting it. Below these recesses are the *Grooves* by which the side-plate springs grip the extractor. Behind its face the extractor is for the most part cut away. At the top is the recess in which the extractor stop on the face of the lock is accommodated, underneath being the stop which engages with it. Immediately below is the seating for the gib and gib spring, alongside being the grooves provided for the gib spring cover. Near the bottom is the hole for the firing-pin, this aperture being coned to fit the shape of the firing-pin, and also slightly recessed at the top. From the top to the bottom of the extractor are grooves which accommodate the ribs at the side of the face of the lock, and which serve as guides for the extractor during its movement.

*Gib*.—This has two projecting portions on the front, the upper projection being smaller and curved at the top, while the lower one is bevelled. The gib is retained by flanges at the side, these lying inside the extractor, while the projections protrude through the face of it. The gib is slightly curved at the back to accommodate the flat *Gib*



Spring by which it is held forward. The *Gib Spring Cover* is a thin plate accommodated by grooves and serving as a seating for the spring.

### Conversion Set for Speeding-up Vickers Gun.

In order to make Vickers Guns more certain of functioning at high altitudes, and also to increase the rate of fire, Conversion Sets are used. As, however, this speeding-up causes considerable extra strain on various parts of the gun, the conversion set should only be fitted to guns properly adapted to its use. This adaptation involves two features:—

1. The insertion of special parts ;
2. The strengthening or modification of existing parts.

The special parts comprise the following:—

**Muzzle Cylinder.**—This is a short cylinder which serves as a lining to the muzzle attachment. Round the sides are bored small holes for the escape of gases generated by the explosion of the charge. One end is entirely open, while the other is closed except for a hole to allow for the passage of the bullets. The part around this hole is reinforced. On the outside, at this end, is a threaded portion by which the cylinder is screwed into the fore end of the muzzle attachment outer casing. Beyond is a flange with four serrations (identical with those in the front cone) by which it is screwed on or removed.

**Buffer Spring.**—This is a strong spiral spring, made in  $3\frac{1}{4}$  to  $4\frac{1}{4}$  flattened coils and placed over the barrel behind the muzzle cup.

**Brass Split Pin.**—This is placed through the roller collar on the right slide, and is rendered necessary by the fact that the standard split pin is liable to work out through vibration.

When the Mark I Gun is used, the parts needing modification are:—

**Left Side Plate.**—Wear takes place with the ordinary pattern after about 4,000 rounds, causing insufficient movement of the feed block, slight cross feeds, and eventual breakage of the right side extractor horn. To avoid these results, the left sideplate must be hardened at the rear end of the recess in the prolongation.

**Front Cover Hooks.**—It has been found that the old pattern hooks are liable to turn back and allow the front cover to fly open. It is consequently necessary to strengthen the hooks by brazing a small stiffening piece to the front of them.

**Rear Cover Lock Spring.**—It has been found that the extra speed of the gun may cause the rear cover to fly open. With the conversion set, therefore, a stronger spring must be used, although—as a purely temporary measure—it is possible to strengthen the standard spring by giving it a little more "set."

**Fusee Spring.**—The ordinary pattern of fusee spring is made from hard drawn wire. For use in the speeded-up gun, springs that have been hardened and tempered are necessary.

**Crank Handle.**—In order to eliminate the somewhat harsh blow at the close of the recoil action, a portion of the crank handle must be removed, in accordance with the diagram on p. 00. The gun then functions more smoothly, and the number of breakages is reduced.



## Mark II (Aerial) Gun.

These guns are prepared for aerial purposes only, and possess the following modifications—made before issue :—

All modifications (as shown above) rendered necessary by the use of the conversion set.

The foresight is removed from the barrel casing.

The steam tube and its keeper screw are absent, together with the plugs and safety chains of the emptying hole, the steam escape hole, and the filling hole.

The front cover has four elongated holes for the fitting of the C.C. Gear "C" Type trigger motor.

The rear cover has the tangent sight bridge removed, and is slotted to accommodate the end of the trigger motor push rod of the "C" Type C.C. Gear.

There is no fusee spring box, the fusee spring adjusting screw being positioned by a skeleton anchorage.

The left traversing handle is removed from the rear crosspiece.

The rear crosspiece is bored and tapped to receive the rounds-counting mechanism.

The following parts of the ordinary firing mechanism are absent : Safety catch (together with its piston and spring), firing lever, trigger bar, and trigger bar lever.

The left and right outer side plates are bored to accommodate the electrical gun heaters.

The top of the lock is hollowed out slightly at the front end to accommodate the trigger motor push rod of the "C" Type C.C. Gear.

The extension at the rear of the right side-plate is bored to accommodate the right-angle bracket of the rounds-counting mechanism.

The sliding shutter and catch are removed.

The elevating stop is removed.

The cams are slightly cut away at the front in a diagonal fashion from top to bottom.

The breech end of the barrel is slightly cut away at the top.

## Method of Instruction.

The teaching of this branch of the work calls for a considerable effort of memory. It should, therefore, be taken in short sections, each of which must be thoroughly understood before the next is attempted.

The general description should be brief, the main idea being to call the attention of the pupils to the peculiarities of the various parts, with a view to their subsequently understanding the mechanism of the gun.

It has been necessary in a few places to introduce parts not yet taught, for the clearer explanation of the particular portion under consideration. On the rare occasions where this is necessary, the instructor should refer to the unknown part without giving its name. The stage at which each new name should be introduced is indicated by italics.



A short general account of the gun should first be given, so that the pupils may get an elementary idea of what the gun is and what it can do, and that their interest may be aroused. This description should not take more than a few minutes, and should touch on the following points :—

*Name* : 303-in. Vickers Machine Gun, and why so called.

*Weight* : (as on p. 00).

*Method of operation* : (as on p. 00).

*Rate of fire* : Normally about 600 rounds per minute : with the aid of a special speeding-up arrangement about 1,000 rounds per minute.

*Component portions* : Recoiling portions and non-recoiling portions. (The instructor should separate the two groups, that they may be clearly understood.)

The instruction should then proceed as follows :—

(a) *Demonstration* :

The instructor strips the gun as far as necessary, and shows in turn the parts under consideration.

(b) *Explanation* :

The instructor

- (i) Gives the official name in each case, taking care that the pupils acquire it correctly.
- (ii) Explains the purpose of this part, without encroaching upon the teaching of mechanism.
- (iii) Shows its relation to the rest of the gun.

(c) *Squad practice* :

The pupils give short descriptions of the parts, using correct names.

(d) *Interrogation* :

By a few rapid questions covering the whole of the section that is being dealt with, the instructor tests the pupils' knowledge of the names and parts.

## II. DRILL (ELEMENTARY).

### I. General Remarks.

- (1) In the elementary stage, this should be carried out :
  - (a) In a fixed stand, the sights being previously aligned on the target by the instructor ;
  - (b) In a movable fuselage, this method being adopted as soon as possible.
- (2) As soon as the pupil's progress permits, he should be made to wear flying gloves.
- (3) The object of the drill is to train the pupil in certain actions



till they become automatic, so that no time may be lost in opening and maintaining fire. These actions are:—

- (a) The raising of the handle of the reservoir of the C.C. Gear to its full height before opening fire, and checking its position before every succeeding burst.

*Note.*—Although the gun will fire several bursts before the handle needs to be pulled up again, the pupil must be trained to raise it at every opportunity, so as to sustain fire for as long a period as possible, and to avoid losing chances.

- (b) The sharp manipulation of the loading handle. This must be carried out in such a manner that faulty feed is avoided.
- (c) Swift and correct alignment of sights on the target, and the maintenance of that alignment during all subsequent actions.

*Note.*—In order to ensure correct and safe manipulation of the gun on the range during his early training, the pupil must be thoroughly familiarised also with the processes necessary for unloading and clearing the gun.

- (4) Before drill commences, the gun should be in the "Gun Clear" position.

(5) The pupil should learn to carry out the necessary manual operations with either hand, keeping the other hand meanwhile on the aeroplane control lever. The assumption must be maintained throughout that he is actually flying and that the fuselage needs to be kept under proper control.

- (6) The gunner should repeat all orders (except "fire!").

## 2. Kit Required.

- (1) Vickers Gun mounted on fuselage, and arranged to fire by means of a Bowden Control lever fixed on the aeroplane control lever.
- (2) Loading handle fitted to gun.

*Note.*—In the early stages the "A" type handle should be used, as it is the simplest and most convenient for beginners to manipulate correctly.

- (3) C.C. Gear so arranged that the trigger motor is actuated without the rotation of the cam shaft. This is achieved by the use of the Essesseff Attachment, which allows the generator to be dispensed with. (See *Pamphlet on Instructional Appliances.*)

- (4) Ring and bead sights at the correct distances from the firer's eye.

- (5) Aldis Sight, if possible.

- (6) Model aeroplane, for use as target. This should preferably be a one-eighth scale model placed at 25 yards from the gun.

- (7) Prideaux links.

- (8) Dummy cartridges.

## 3. Preliminary.

On the command "Fall in" the squad takes up position in line, five yards in rear of the fuselage. The squad then numbers.



#### 4. Details of Drill.

Commands.	Details of Actions.
I. "No. . . . . Detail, take post!"	<p>(NOTE.—Before any detail takes up his position in the fuselage, the instructor inserts in the feed block a belt of 12 dummy rounds, so that the first round is gripped by the bottom pawls.)</p> <ol style="list-style-type: none"> <li>1. Double to fuselage.</li> <li>2. Take up position in fuselage.</li> </ol>
II. "Lock in!"	<ol style="list-style-type: none"> <li>1. Pull back crank handle, until lock falls into position in guides.</li> <li>2. Release crank handle. (This must be let go while in the backward position, and not eased forward.)</li> <li>3. Lower rear cover.</li> </ol>
III. "Load!"	<ol style="list-style-type: none"> <li>1. Operate loading-handle smartly. (Enough force must be applied to carry out the loading process completely: the handle must not be gripped or eased forward.)</li> <li>2. Operate loading-handle again.</li> <li>3. Pull up handle of C.C. gear reservoir to the top of its stroke.</li> </ol>
IV. "At aeroplane!"	<ol style="list-style-type: none"> <li>1. Place head at correct distance from the ring.</li> <li>2. Align sights on mark, maintaining head at proper distance from the ring.</li> </ol> <p>(NOTE.—From this time on, the pupil must keep his eye on the target.)</p> <ol style="list-style-type: none"> <li>3. Grip Bowden control lever, ready for firing. (Full control of the aeroplane lever must be maintained.)</li> </ol>
V. "Fire!"	<ol style="list-style-type: none"> <li>1. Press Bowden control lever.</li> </ol>
VI. "Unload!"	<ol style="list-style-type: none"> <li>1. Release Bowden control lever.</li> <li>2. Pull back crank handle on to roller.</li> <li>3. Let go crank handle. (The handle must be liberated while in the rearward position, and not eased forward first.)</li> <li>4. Repeat 2 and 3.</li> </ol>
Nos. III., IV., V. and VI. above should be repeated until all the dummy rounds are used. The Drill should then proceed as follows:—	
VII. "Clear gun!"	<ol style="list-style-type: none"> <li>1. Raise rear cover.</li> <li>2. Hang lock.</li> <li>3. Grip lock tightly, placing first or second finger on face of extractor and thumb on rear of casing.</li> <li>4. Force lock upwards and backwards, lifting it clear of guides and pressing crank handle on to roller.</li> <li>5. Maintaining backward and downward pressure, bring lock to the rear, until the crank is carried forward by the fusee spring and rests on crankstops.</li> <li>6. Lower lock and rest it diagonally against rear cover.</li> </ol>
VIII. "Stand clear!"	<ol style="list-style-type: none"> <li>1. Return to position in squad.</li> </ol>



## 5. Method of Instruction.

### (a) *Demonstration :*

The instructor demonstrates :—

(i.) The complete Drill, taking care to set an example of clean and correct action.

(ii.) The section about to be taught.

### (b) *Explanation :*

The instructor explains in detail the section to be practised, showing clearly the various points requiring attention and mistakes to be avoided.

### (c) *Squad Practice :*

Each member of the squad carries out the section just demonstrated and explained, the instructor criticising after each attempt.

### (d) *Interrogation :*

The instructor tests the pupils' knowledge of the sequence of the actions and the points to be observed.

## III. STRIPPING.

### 1. General Remarks.

(1) When the gun is stripped, all parts should be laid out in order, and so placed that they are kept clean and undamaged.

(2) Wherever a tool is required, it is essential to use only the correct one for the particular part concerned. If this rule is not observed, screws and other parts of the gun become burred and otherwise damaged.

(3) Before an attempt is made to withdraw screwed axis pins, care should be taken to see that the threads are fully disengaged.

(4) In the replacement of screwed axis pins, no force should be used. The threads will engage without unnecessary pressure. If this rule is not observed, the threads (which are very fine) will become so burred that it is impossible to replace pins.

(5) When the rear cover is being raised, it should not be thrown upwards, but lifted. Improper treatment may easily strain the hinges.

(6) Before the rear cover is lowered, it is necessary to see that the lock is properly placed in the gun, and that the Foroto or other rear cover catch (if used) is clear.

(7) Before the front cover is closed, the feed block must be in the correct position with the slide as far over to the left as it will go. Also the front cover catch must be raised.

(8) Whenever the lock is allowed to go forward, the trigger should be tripped to ease the lock-spring.

(9) With reasonable care, defects and breakages should be of extremely rare occurrence. They are due merely to the neglect of ordinary precautions.



## 2. Sequence of stripping the gun.

- (1) Outer casing of muzzle attachment.
- (2) Muzzle cup.
- (3) Feed block.
- (4) Lock.
- (5) Fusee spring box and fusee spring.
- (6) Fusee.
- (7) T-fixing pin.
- (8) Left and right slides.
- (9) Barrel and side-plates.

## 3. Details of stripping the gun.

- (1) Withdraw the split pin securing the outer casing of the muzzle attachment to the packing gland.  
Give the outer casing one-sixth of a turn.  
Draw off outer casing.
- (2) Unscrew the muzzle cup, using the combination tool.  
Remove the muzzle cup, taking care that the .05 washer is not dropped out.
- (3) Lift up the front cover catch.  
Raise the front cover.  
Take out the feed block.
- (4) Pull back the crank handle on to the roller.  
Raise the rear cover.  
Grasp the lock, holding the extractor down at its lowest point by means of the forefinger.  
Ease crank handle slowly forward, till the lock is released from the side-plates.  
Lift the lock clear of the breech casing.  
Give the lock one-sixth of a turn.  
Remove the lock from the connecting-rod.  
Let the crank handle go right forward, keeping the right thumb on the milled portion of the connecting-rod in order to prevent the latter from turning back under the crank.
- (5) Grasp the fusee spring box with the right hand at the rear, and the left hand at the front.  
Press the fusee spring box forward, till it is clear of the positioning-studs.  
Remove the fusee spring box, avoiding side strain on the fusee chain.  
Disconnect the fusee spring from the fusee chain.
- (6) Turn the fusee to the rear, till the lugs on its stem are free to be withdrawn.  
Pull out the fusee.
- (7) Unscrew the T-fixing pin three complete turns.  
Pull out the T-fixing pin.



- (8) Lower the rear crosspiece.  
Pull left and right slides out to the rear.
- (9) Draw out the recoiling portions by means of the crank handle and the connecting rod.  
Separate the side-plates from the barrel, disconnecting the left side-plate first.

#### 4.—Re-assembling.

- (1) Place the barrel partially in position in the casing, leaving the trunnions clear of the rear crosspiece.  
Replace the left side-plate on the barrel trunnion.  
Replace the right side-plate, first fitting the rear end to the left side-plate, and then the front end to the barrel trunnion.  
Slide the recoiling portions forward into position by means of the crank handle and the connecting-rod.  
Leave the crank handle in the forward position.
- (2) Replace left and right slides.
- (3) Raise the rear crosspiece.  
Insert the T-fixing pin, pressing down the top of the trigger bar lever if necessary.  
Screw up the T-fixing pin three turns.
- (4) Replace the fusee, keeping the fusee chain uppermost.  
See that the fusee is fully home, and turn the fusee chain forwards over the top of it.
- (5) Connect the fusee spring with the fusee chain, taking care not to pull the fusee out of position.  
Replace the fusee spring box, holding it as before, and making sure that the claws are in line with the positioning-studs before releasing the forward pressure.
- (6) Pull back the crank handle, and raise the connecting-rod by pressure of the right thumb on the milled portion.  
Replace the lock on the connecting-rod, holding down the extractor as before.  
Give the lock one-sixth of a turn to bring it to the vertical.  
Lower the lock into position in the breech casing, making sure that it is properly in position in the guides.  
Test the position of the lock with the palm of the left hand.  
Lower the rear cover.  
Allow the crank handle to go right forward.  
Ease lock-spring.
- (7) Raise the front cover.  
Replace the feed block, pressing the slide over to the left as far as it will go, and making sure that the stud on the lower lever is engaged in the recess in the left side-plate.  
Lower the front cover.  
Lower the front cover catch.
- (8) Screw on the muzzle cup, taking care not to drop the .05 washer.  
Tighten the muzzle cup with the combination tool, taking care not to screw it so far as to burr the threads.



- (9) Replace the outer casing of the muzzle attachment, so that the safety chain is on the lower side.
- Give the outer casing one-sixth of a turn.
- Replace the split pin in the lowest hole.

### 5.—Details of Stripping Component Parts.

#### (1) *Lock :*

- See that the lock is fully cocked.
- Force out the side lever axis bush split pin.
- Take out side lever axis bush.
- Slide off side levers and side lever head.
- Remove extractor levers.
- Take off extractor.
- Force out tumbler axis pin.
- Take out tumbler.
- Release lock spring by depressing sear.
- Force out trigger axis pin.
- Take out trigger.
- Take out lock spring.
- Depress sear, and allow firing-pin to slide out.
- Move sear 45 degrees, and take out.
- To assemble lock, reverse the above, except in the case of the lock spring, which must be forced home (with the long arm towards the extractor) when the other parts are assembled and the lock is in the fired position.

#### (2) *Extractor :*

- Push out the gib spring cover, and remove gib and spring.
- N.B.*—The firing-pin should never be released unless the extractor is up against the extractor stop.

#### (3) *Feed Block :*

- Force out the split pin.
- Separate the top and bottom levers, using a No. 5 punch.
- Take out the slide.
- Remove top pawls and spring.
- Draw out the bottom pawl axis pin.
- Remove bottom pawl spring and pawls.
- To assemble feed block, reverse the above.

#### (4) *Rear Cross-piece :*

- Unscrew the firing lever axis pin.**
- Remove the firing lever.**
- Unscrew the safety catch axis pin.**
- Remove the safety catch and spring with piston.**
- Lift out the trigger bar lever.**
- To assemble the rear cross-piece, reverse the above order. See that the pawl engages the trigger bar lever.**

#### (5) *Front and Rear Covers :*

- Remove keeper pin and check nut.
- Force out joint pin.
- To assemble, reverse the above.



(6) *Front Cover Catch :*

To remove the spring and plunger, force the plug inward, and give a quarter turn by means of a screwdriver, when the plug will be forced out by the spring. Before removing the plunger, it must be turned so that the slots are free to pass the lugs in the catch. If necessary, by taking out the keeper pin, the catch can be taken out.

(7) *Cover Lock :*

Unscrew and take out axis pin.  
Remove cover lock and spring.  
To assemble, reverse the above.

(8) *Trigger Bar :*

**Strip cover lock.**  
**Remove trigger bar spring.**  
**Withdraw trigger bar.**  
**To assemble, reverse the above.**

(9) *Steam Tube :*

**Place the gun on end : so that it stands on the rear end of the breech casing.**

**Remove the keeper screw.**

**Unscrew the steam tube, using the special tool provided. (This should not be removed if the valve is moving freely.)**

**To assemble, reverse the above, taking care that the acorn end is inserted into its thimble in the barrel casing. This is more easily assured by keeping the acorn end in contact with the adjacent channel formed by corrugation of the barrel casing. The tube should screw home freely when in the correct position.**

### Method of Instruction.

For instructional purposes, stripping-guns only should be used.

During instruction, no time limit must be imposed. Ability to strip the gun correctly (or, in the case of instructor-pupils, to teach how it should be stripped correctly) will form the basis of all stripping examinations. Time tests are, however, permissible when pupils are proficient.

The lessons should take the following form :—

(a) *Demonstration :*

The instructor strips (or assembles) the gun, or the part of it under consideration, in such a manner that every step is clearly seen by the pupils.

(b) *Explanation :*

The instructor :—

- (i) Explains the method to be followed ;
- (ii) Emphasises points requiring special attention ;
- (iii) Indicates errors to be avoided.

(c) *Squad Practice :*

The pupils in turn carry out the processes demonstrated by the instructor.



*Note.*—As much practice as possible should be given to pupils, so that they may learn to handle the gun cleanly and correctly, without doing damage. The facilities should be as equal as possible for all the pupils in a squad. If, therefore, a lesson ends without affording to some an opportunity for carrying out the work, these pupils should be the first called upon in the subsequent lesson.

(d) *Interrogation :*

The instructor questions the class to see that the points laid down in (b) above are known and understood.

#### IV. MECHANISM.

The mechanical processes of the gun are rapid and complex, but in order to ensure a proper comprehension of what takes place the complete cycle of operations—in reality almost simultaneous—is analysed into its component stages, each of these being treated separately. In the account given below, the following conditions are assumed :—

- (1) The gun has been fully loaded with live rounds which form part of a belt of cartridges.
- (2) The thumb-piece of the firing-lever has been pressed, and pressure is being maintained, thus giving continuous fire.

##### 1. Action of Recoil.

When the explosion of the charge takes place, the cordite is turned into gases under high pressure. As a result the bullet is driven along the barrel, the gases following in their attempt to escape. Meanwhile by direct recoil action the recoiling portions are forced to the rear, through a distance of approximately one inch, the fusee spring being thereby partially extended. This backward movement is assisted by the further action of the gases in the outer casing of the muzzle attachment. As soon as the bullet is clear of the muzzle end of the barrel, the gases strike against the front cone and rebound on to the muzzle cup, thus contributing an extra impetus to the movement of the recoiling portions. The gases then escape through the vents in the outer casing of the muzzle attachment.

##### 2. First action of the feed block.

At the moment when the explosion takes place, the top pawls are holding a round in position against the cartridge and bullet stops, while a second round is engaged by the bottom pawls. As the recoiling portions are driven to the rear, the recess in the prolongation of the left side-plate carries back with it the stud on the bottom lever of the feed block. The bottom lever acts on the top lever, and the slide is moved over from left to right. The top pawls are thereby carried over the cartridge already held by the bottom pawls, but, under the influence of the top pawls spring, they are forced down immediately afterwards and engage behind it.



### 3. Backward rotation of the crank.

During the backward movement of the recoiling portions, the tail of the crank handle bears upon the roller and the crank is thereby rotated. This rotation of the crank draws back the lock from the barrel, thus opening the breech. The fusee is turned to the rear, winding the fusee chain and further extending the fusee spring. As the portion of the crank handle beyond the depression bears on the roller, the recoiling portions, with the exception of the lock, begin to travel forward, this movement being assisted by the tension of the fusee spring. The lock meanwhile continues its backward movement for a short distance, and then joins with the rest of the recoiling portions in their forward movement.

### 4. Backward movement of the lock.

When the explosion has taken place, the extractor is gripping a live round in the feed block and an empty case in the chamber. The live round is held between the upper and the lower projections on the gib, while the empty case is below the lower projection. As the lock moves to the rear, the horns of the extractor ride along the top of the cams, and both the live round and the empty case are withdrawn. When the extractor reaches the end of the cams it is forced down by the ramps on the rear cover. The live round is thus brought in line with the chamber, while the empty case probably falls off and drops through the ejection opening. If the empty case remains on the extractor it is now ready for ejection at a later stage of the action.

### 5. Cocking action of the lock.

As the crank rotates backwards, the connecting-rod and the side lever head receive an upward and rearward movement. The tail of the tumbler is lifted so that the tumbler itself rotates on its axis, and, by means of the head of the tumbler, the firing-pin is forced to the rear. The lock-spring, which is already under compression between the firing-pin and the nose of the trigger, is further compressed, and its short arm forces the nose of the trigger to pass over the bent of the tumbler, although the continued rotation of the crank affords it no opportunity to engage therein. As the upward movement of the side lever head goes on, the tumbler is still further rotated and the firing-pin drawn to the rear—the lock-spring being more and more compressed—until the bent of the sear engages with the bent of the firing-pin. The firing-pin is thus held right back and the lock is fully cocked.

### 6. Second action of the feed block.

As the recoiling portions go forward, the recess in the prolongation of the left side-plate carries with it the stud on the bottom lever of the feed block. The bottom lever acts on the top lever, and the slide is



moved from right to left. The top pawls are thereby carried to the left, taking with them the cartridge behind which they are engaged, and pressing it into position against the cartridge and bullet stops. The next cartridge in the belt rides meanwhile over the bottom pawls. The pawls are depressed, but, under the influence of the bottom pawls spring, they rise up immediately behind the cartridge, thus holding it in position and preventing the belt from slipping back when the round in front is withdrawn.

### **7. Forward Rotation of the Crank.**

The force of the explosion being now expended, the fusee spring takes full control of the action, and unwinds the fusee chain from the fusee. This causes a forward rotation of the crank, and imparts a forward and downward movement to the connecting-rod and side lever head. These gradually straighten out, carrying the lock forward.

### **8. Forward movement of the lock.**

As the lock travels forward, the live round on the face of it is gradually forced into the chamber, and the side levers act upon the extractor levers, causing the extractor to rise. During the latter process, the upper projection of the gib rides over the base of the new round already in position in the feed block, until that round is between the two projections, the lower projection having meanwhile ridden over the base of the round in the chamber. The firing-pin hole is gradually brought opposite the firing-pin and the cap of the cartridge in the chamber. The empty case, if it has not already fallen off the extractor, is forced off by the seating for ejection as the extractor rises. After the extractor reaches its highest position against the extractor stop, the lock travels still further forward for a short distance until the breech is closed. During this last movement, the steps on the side levers engage with the bents on the extractor levers, thus holding the extractor steady. Meanwhile, the side lever head presses upon the tail of the sear, which is forced down so that the bent on the firing-pin is freed from the bent on the sear, whereupon the firing-pin is immediately carried forward under the influence of the lock-spring.

### **9. Firing action (continuous fire).**

Since pressure is being maintained on the thumb-piece of the firing lever, the firing lever pawl is held forward, thus keeping the head of the trigger bar lever to the rear. This holds back the trigger bar, so that as the lock goes forward the tail of the trigger is tripped before the lock is quite home. The trigger is in consequence forced out of contact with the tumbler, and its nose is prevented from engaging in the bent of the tumbler as, under the influence of the lockspring, it would otherwise do. When, therefore, the sear is depressed, the firing-pin moves forward until it strikes the cap of the live round in the chamber and explodes the charge.



### 10. Cessation of Fire.

When the pressure on the thumb-piece of the firing lever is released, the safety catch spring presses forward the top of the trigger bar lever and allows the trigger bar to go forward under the influence of its own spring. When, therefore, the lock goes home the next time, the tail of the trigger is not affected by the trigger bar, and the nose of the trigger remains in contact with the tumbler. Consequently, when the sear is depressed, the forward movement of the firing-pin is interrupted by the engagement of the nose of the trigger in the bent of the tumbler, so that the firing-pin is unable to move sufficiently far to reach the cap of the round in the chamber.

### 11.—Firing Action (Opening or Resuming Fire).

When the thumb-piece is pressed, in order to open or resume fire, the trigger bar is pulled to the rear by the operation of the firing lever pawl and trigger bar lever (as described above). The tail of the trigger is, therefore, drawn back by the front end of the slot in the trigger bar. By this means the nose of the trigger is disengaged from the bent of the tumbler, the firing-pin being thereby freed, so that under the influence of the lock-spring it is carried forward till it strikes the cap of the round in the chamber.

#### Note on the Closing of the Breech.

In accordance with the usual custom, safety devices are provided to allow an infinitesimally small interval of time :—

- (a) Between the closing of the breech and the explosion of the charge. (This ensures that the breech is properly sealed before round in the chamber is fired).
- (b) Between the priming of the cartridge and the opening of the breech. (This ensures that the breech is kept closed until the bullet reaches the muzzle and the pressure of the gases on the face of the lock is dispersed).

The first of these two precautionary measures is effected by timing the depression of the sear so that the firing-pin cannot be released until the lock is in the firing position and the breech closed.

The second safety provision is arranged for as follows. At the moment when the side lever head depresses the tail of the sear, the crank pin is forced by the rotation of the crank slightly below a straight line joining the centres of the crankshaft and the side levers axis bush. The lock is thereby drawn back a very small distance, but this movement is not sufficient to affect the closing of the breech. The shock of the explosion first tends to force the crank pin still further downwards, thus preventing an upward movement of the side lever head and a premature opening of the breech. These conditions remain unchanged while the tail of the crank handle moves back through a small clearance between itself and the roller, by the end of which time the bullet has reached the muzzle and the breech may safely be opened.



### Mechanical Process of Loading (with loading handle).

When the loading-handle is operated, it pivots on the special rear crosspiece axis pin provided, so that first the recess at the front of the handle raises the knob of the crank handle, withdrawing the lock and rotating the crank until the extractor is clear of the cams and is forced down by the ramps. The central portion of the loading-handle is meanwhile brought into contact with the boss of the crank handle, which is thereby forced to the rear, drawing back the recoiling portions. These in turn actuate the feed block, so that it carries out its first action. The force of the stroke on the loading-handle is now expended, and the fusee spring comes fully into action, carrying forward the recoiling portions, and effecting the second action of the feed block. When the loading handle is released the crank rotates so that the lock is carried forward.

### Mechanical Process of Unloading.

At the moment when the gunner stops firing, the extractor is gripping a live round in the feed block, and a live round in the chamber—assuming that the belt is not exhausted. When the crank handle is pulled back on to the roller for the first time, both cartridges are withdrawn without operation of the feed block. On the release of the crank handle, the lower live round is ejected (if it has not already fallen off), while the upper one is placed in the chamber. The extractor is now gripping one live round only, and by a second operation of the crank handle this is ejected in the usual manner.

### Effect of the Conversion Set on the Action of the Gun.

The purpose of the conversion set is to accelerate the rate of fire of the gun from about 600 rounds per minute to about 1,000 rounds per minute. This is effected by speeding-up both the recoiling action and the return action.

(a) *Recoiling Action*.—The gas generated by the explosion of the charge is compelled to escape through the small holes of the muzzle cylinder instead of directly through the larger vents in the muzzle attachment outer casing, the means of escape being therefore considerably reduced. This results in more gas being temporarily trapped, and the impetus given by the rebound of the gas from the front cone on to the muzzle cup is increased. The recoiling portions are thus driven to the rear more quickly and with greater force, the latter being sufficient to compress the buffer spring and store up a larger reserve of energy for the return action.

(b) *Return Action*.—The forward force exerted by the fusee spring being thus supplemented, the velocity of the forward movement of the recoiling portions is considerably increased.

### Method of Instruction.

1. The mechanism of the gun offers difficulty to beginners on account of the rapidity and complexity of its action. The work should,



therefore, first be taken slowly and one section at a time. When this has been done, the stages should be recapitulated in groups until finally the pupil is able to give a clear and complete account of all the mechanical processes. The object of teaching him the mechanism in detail is to rouse his interest and give him an intelligent understanding of the gun, but under no circumstances should he be required or permitted to learn by rote the exact wording set down in the official account, nor to recite it in parrot fashion.

2. For demonstrating the mechanical action, D.P. locks and dummy rounds with wooden bullets should be used. Live ammunition must never be brought near the gun during instruction.

3. At every stage of the work careful setting-up of the gun is necessary, in order to display the mechanical processes to greatest advantage. The instructions given below for each section of the teaching should be strictly followed. The directions in each case assume that at the beginning of the teaching the gun is fully assembled.

4. Diagrams and models should be used wherever possible.

5. Before instruction is commenced, pupils must have a full knowledge of the following points. This should have been already acquired during the teaching of *General Description* :

- (a) Relation of parts of feed-block to one another.
- (b) Relation of feed-block to recoiling portions.
- (c) Relation of parts of lock to one another.
- (d) Relation of parts of firing mechanism to one another.

6. The following is the sequence in which instruction in mechanism should be given. Each stage must be thoroughly understood before the next is attempted.

- (1) Action of Recoil.
- (2) First Action of the Feed-Block.
- (3) Backward Rotation of the Crank.
- (4) Backward Movement of the Lock.
- (5) Cocking Action of the Lock.
- (6) Second Action of the Feed-Block.
- (7) Forward Rotation of the Crank.
- (8) Forward Action of the Lock.
- (9) Firing Action (Continuous Fire).
- (10) Cessation of Fire.
- (11) Firing Action (Opening or Resuming Fire).

### **Kit Required.**

- 1. Gun, fitted to some form of mounting, and having D.P. lock.
- 2. Sectioned gun (if possible).
- 3. Spare feed-block.
- 4. Spare lock.
- 5. Metal, wooden, or skeleton lock.
- 6. Skeleton front anchorage for fusee spring adjusting screw. (This should be similar to the pattern used on the Mark II gun, and should be substituted for the fusee spring box throughout the teaching of the mechanism.)



7. Articulated links.
8. Dummy cartridges.
9. Empty case (dummy without bullet).
10. Loading handle.
11. Instructional diagrams.
12. Strong elastic band.

## METHOD OF TEACHING.

### 1.—Action of Recoil.

- (a) *Preparation of Gun :*  
 Remove outer casing of muzzle attachment.  
 Remove feed-block.  
 Ease fusee spring to lowest possible tension.  
 Raise rear cover.
- (b) *Demonstration :*  
 Push back recoiling portions by :  
 (i.) Pressing on face of lock ;  
 (ii.) Striking muzzle cup.
- (c) *Explanation :*  
 (i.) When the explosion takes place the cordite is turned to gases, which rush along the barrel behind the bullet.  
 The force of the explosion, acting on the face of the lock, drives the recoiling portions to the rear.  
 (ii.) When the bullet reaches the muzzle, the gases strike the front cone and rebound on to the muzzle cup.  
 The backward movement of the recoiling portions is thereby assisted, the extent of backward travel being about 1 in.  
 Fusee spring is extended.  
 Gases escape through vents in outer casing.
- (d) *Squad Practice.*  
 Individual members of the squad give an account as outlined above, including all details, stating the facts clearly and accurately, but not necessarily using the exact wording of the Instructor.
- (e) *Interrogation :*  
 Instructor questions pupils to ensure that they have intelligently grasped the facts.

### 2. First action of feed block.

- (a) *Preparation of Gun :*  
 Remove outer casing of muzzle attachment.  
 Remove right and left slides.  
 Remove fusee spring.  
 Raise front cover.
- (b) *Demonstration :*  
 With feed-block in position in gun, demonstrate first action by striking blow on muzzle cup.



With feed block out of gun, demonstrate first action by pressing back lower lever with fingers.

(c) *Explanation :*

When the explosion has taken place, the top pawls are holding a live round against the cartridge and bullet stops, while the bottom pawls are engaged behind the next cartridge.

Stud on lower lever is driven back by prolongation of left side-plate.

Bottom lever acts on top lever.

Slide is moved from left to right.

Top pawls ride over cartridge held by lower pawls and engage behind it.

*Note.*—Further explanation (if necessary) can be given with feed-block removed from gun and containing one dummy round.

(d) *Squad Practice :*

As before.

(e) *Interrogation :*

As before.

### 3. Backward Rotation of the Crank.

(a) *Preparation of Gun :*

Remove outer casing of muzzle attachment.

Remove fusee spring, and substitute strong elastic band.

Raise rear cover.

(b) *Demonstration :*

(i.) Push on muzzle cup till depression of crank handle bears on roller.

(ii.) Push on face of lock.

(c) *Explanation :*

(i.) Tail of crank handle bears on roller.

Lock is withdrawn from barrel block, and moved backwards independently of the barrel and side-plates.

Fusee is turned to the rear, winding up fusee chain.

Fusee spring is thereby further extended.

(ii.) Portion of crank handle beyond depression bears on roller.

This action, together with tension of fusee spring, forces barrel and side-plates forward till right home.

Crank is meanwhile rotated further backwards, withdrawing lock, which still moves to the rear for about 1 in. and then goes slightly forward.

*Note.*—During the second part of this action the fusee chain is still wound up, but the further extension of the spring so caused is practically neutralised by the simultaneous forward movement of the recoiling portions.

(d) *Squad Practice :*

As before.

(e) *Interrogation :*

As before.



#### 4. Backward Movement of the Lock.

(a) *Preparation of Gun :*

Fully load, using belt, the leading round of which is an empty case.

Raise rear cover.

See that lock is in the " fired " position.

(b) *Demonstration :*

Pull back crank handle slowly on to roller.

(c) *Explanation :*

After explosion, extractor is gripping live round in feed-block (between upper and lower projections of the gib) and empty case in chamber (below lower projection of the gib).

As lock moves back, both live round and empty case are withdrawn.

The horns of the extractor ride along the top of the cams.

When the horns reach the end of the cams, they are driven against the ramps and forced down until the extractor assumes its lowest position.

The live round is now in line with the chamber.

The empty case has either fallen off through the ejection opening or is below the level of the ejection seating.

(d) *Squad Practice :*

As before.

(e) *Interrogation :*

As before.

#### 5. Cocking Action of the Lock.

(a) *Preparation of Gun :*

As in Section 5.

(b) *Demonstration :*

(i.) Pull back crank handle slowly on to roller.

(ii.) Use metal or wooden model of lock, or skeleton lock.

(c) *Explanation :*

(i.) Backward rotation of crank handle causes upward movement of side lever head.

Tail of tumbler is lifted.

(ii.) Tumbler is rotated.

Head of tumbler forces firing pin to the rear.

Lock spring is compressed.

Nose of trigger rides over bent in tumbler, but does not engage owing to continued movement of side lever head.

Tumbler continues to rotate ; firing pin is further withdrawn to the rear.

Lockspring is still more compressed.

Bent on sear engages in bent on firing pin.



## 6. Second Action of Feed Block.

- (a) *Preparation of Gun :*  
 Remove outer casing of muzzle attachment.  
 Remove fusee spring.  
 Insert belt in feed-block, till first cartridge is held by bottom pawls.  
 Push muzzle cup till depression of crank handle is on roller.  
 Raise front cover.
- (b) *Demonstration :*  
 With feed-block in position in gun, demonstrate second action by pushing forward recoiling portions.  
 With feed block out of gun, demonstrate second action by pressing forward lower lever with fingers.
- (c) *Explanation :*  
 At beginning of forward movement of recoiling portions, top and bottom pawls are all engaged behind the same cartridge. Stud on lower lever is driven forward by prolongation of left side-plate.  
 Bottom lever acts on top lever.  
 Slide is moved from right to left.  
 Top pawls carry over to cartridge and bullet stops the cartridge behind which they are engaged.  
 The next cartridge rides over the bottom pawls. These are depressed, but rise up immediately behind it.  
*Note.*—Further explanation (if necessary) can be given with feed-block removed from gun and containing one dummy round.
- (d) *Squad Practice :*  
 As before.
- (e) *Interrogation :*  
 As before.

## 7. Forward Rotation of the Crank.

- (a) *Preparation of Gun :*  
 Pull back cocking handle on to roller.  
 Raise rear cover.
- (b) *Demonstration :*  
 Ease cocking handle slowly forward.
- (c) *Explanation :*  
 Force of explosion spent.  
 Fusee spring takes control.  
 Fusee chain unwound from fusee.  
 Crank rotated forward.  
 Connecting rod and side lever head receive forward and downward movement.  
 Lock carried forward.
- (d) *Squad Practice :*  
 As before.
- (e) *Interrogation :*  
 As before.



## 8. Forward Movement of the Lock.

### (a) *Preparation of Gun :*

Raise rear cover.

Place round on face of extractor between upper and lower projections of gib.

Pull back cocking handle on to roller.

Holding back cocking handle, insert belt in feed-block till first round is against cartridge and bullet stops.

### (b) *Demonstration :*

Ease crank handle slowly forward.

### (c) *Explanation :*

(Using spare lock and sectioned model lock).

*Note.*—Tail of trigger must be held back when firing pin goes forward.

Live round is forced into chamber.

Side levers bear on extractor levers.

Extractor lifted.

Upper projection of gib rides over base of round in feed-block.

Lower projection of gib rides over base of round in chamber.

Firing pin hole brought into line with firing pin and cap.

Empty case (if still on extractor) is forced off by seating for ejection

Breech is closed.

Steps on side levers engage with bents on extractor levers.

Side lever head presses on tail of sear.

Bent on firing pin is released from bent on sear.

Firing pin carried forward.

### (d) *Squad Practice :*

As before.

### (e) *Interrogation :*

As before.

## 9. Firing Action (Continuous Fire).

### (a) *Preparation of Gun :*

Load.

Remove trigger bar and lay it in position, on lock and trigger bar lever.

Leave rear cover raised.

Pull back cocking handle on to roller.

### (b) *Demonstration :*

Keeping thumb-piece of firing lever pressed, allow crank handle to go slowly forward.

Maintain pressure on thumb-piece of firing lever.

### (c) *Explanation :*

(Using spare lock and model sectioned lock).

Firing lever pawl is held forward.

Lower end of trigger bar lever is thus held forward, while upper end is kept to the rear.

By this means trigger bar is held to the rear.



As lock goes forward, the tail of the trigger is engaged by the slot in the trigger bar before the lock is home.

Nose of the trigger is thereby prevented from engaging in bent of tumbler.

When sear is depressed, lock-spring carries firing pin right forward.

(d) *Squad Practice :*

As before.

(e) *Interrogation :*

As before.

## 10. Cessation of Fire.

(a) *Preparation of Gun :*

Load.

Remove trigger bar and lay in position on lock and trigger bar lever.

Leave rear cover raised.

Maintain pressure on thumb-piece of firing lever.

Pull back cocking handle on to roller.

(b) *Demonstration :*

Release pressure on thumb-piece, at same time pushing forward trigger bar with forefinger.

Allow cocking handle to go slowly forward.

(c) *Explanation :*

(Using spare lock and sectioned model lock).

When thumb-piece of firing lever is released, lower end of trigger bar lever is no longer held forward.

Top of trigger bar lever is pressed forward by safety catch spring.

Trigger bar is carried forward by trigger bar spring.

Next time lock goes forward, trigger remains unaffected and nose of trigger is kept in contact with tumbler by lock-spring.

When sear is depressed, firing pin is carried forward, rotating tumbler till bent in tumbler is engaged by nose of trigger.

Firing pin is partially withheld to rear.

## 11. Firing Action (Opening or Resuming Fire).

(a) *Preparation of Gun :*

Load.

Remove trigger bar and lay in position on lock and trigger bar lever.

Leave rear cover raised.

(b) *Demonstration :*

Press trigger.

(c) *Explanation :*

(Using spare lock, and sectioned model lock).

When thumb-piece of firing lever is pressed, pawl on firing lever forces forward lower end of trigger bar lever.



Upper end of trigger bar lever is forced to rear.  
 Trigger bar pulled back.  
 Front end of slot in trigger bar draws back tail of trigger.  
 Nose of trigger is disengaged from bent of tumbler.  
 Firing pin is carried forward by lock-spring on to cap of cartridge in chamber.

(d) *Squad Practice :*

As before.

(e) *Interrogation :*

As before.

## V. CARE AND CLEANING.

- (1) Importance of subject.
- (2) Instructional kit required for teaching.
- (3) General points.
- (4) Wear in bore.
- (5) High polish on interior of new barrel.
- (6) Kinds of fouling :—
  - (a) Internal ;
  - (b) Superficial.
  - (c) Metallic.
- (7) Removal of fouling.
- (8) Daily cleaning.
- (9) Weekly cleaning.
- (10) How to use the steel cleaning rod.
- (11) How to put on the gauze.
- (12) How to use the double pull-through.
- (13) Cleaning with boiling water.
- (14) Oils.
- (15) Care and cleaning of speeded-up Vickers Guns.

### (1) Importance of Subject.

Careful attention should be given to this branch of the instruction, in order that the gun may fulfil to the utmost of its power any task demanded of it from a mechanical point of view, and in order to obtain the maximum results when fire is applied.

### (2) Instructional Kit required for Teaching.

Gun.  
 Spare parts.  
 Spare barrel.  
 Metal links.  
 Dummy cartridges.  
 Steel cleaning rod for barrel (with movable bush).  
 Double pull-through.  
 Gauze.  
 Flannelette and old linen.



Lubricating oil, turpentine and paraffin.  
 Barrel reflector.  
 Spring balance.  
 Boiling water.

### (3) General Points.

The instructor should explain the necessity of the following :—

- (a) Guns should be examined daily after cleaning.
- (b) Avoid damage to gun through careless handling.
- (c) Never play with the crank handle unless the lock is in the gun. The reason for this is that the interrupted flange of the connecting rod dents the bottom plate.
- (d) Never keep the lock spring compressed unnecessarily.
- (c) **See that the milled head brushes are kept secure.**
- (f) See that all points taught in Stripping and Examination of Gun are observed.
- (g) The browning on the barrel and gun must be preserved, as it is a protection against rust.

### (4) Wear in Bore.

Wear in the bore of machine guns is due to three causes :—

- (a) The friction of the bullet.
- (b) The heat generated when ammunition is fired.
- (c) The friction of the pull-through gauze when the bore is being cleaned.

Undue wear is caused by improper and unnecessary use of the pull-through gauze, to prevent which it is most important that instructions for cleaning be adhered to.

### (5) High Polish of Interior of New Barrel.

The interior of a new barrel carries a high polish, and this is a safeguard against rust and metallic fouling, but it must be recognised that as the bore becomes worn this polish will diminish. Efforts to restore it with wire gauze on the pull-through result in unnecessary wear. But though the polish may diminish, it must be understood that the lands should be bright and free from stain of rust or fouling.

### (6) Kinds of Fouling.

In order that the instructions for cleaning may be understood, it is essential that the causes of fouling in barrels should be briefly explained.

Fouling may be said to be of three kinds :—

- (a) *Internal* : Caused by the forcing of the products of combustion into the pores of the metal.
- (b) *Superficial* : Caused by the deposit, in the bore, of the solid products of the charge and of the cap composition.



- (c) *Metallic* (Nickelling): Caused by a portion of the cupronickel envelope of the bullet being left on the bore. It appears as a whitish streak on the lands, or as a roughness on the edge of the grooves. If deposited near the muzzle or the breech, it is visible to the eye when the bore is clean, but it can only be detected in the centre of the bore by use of the gauge plug. It is a cause of inaccuracy, and, if the gun shoots badly for no apparent reason, its presence should be looked for as a possible explanation.

### (7) Removal of Fouling.

Fouling may be removed by the following means:—

- (a) *Internal Fouling*.—This may be removed satisfactorily by the use of boiling water. If for any reason this method cannot be used, the barrel will “sweat,” and a hard black crust of fouling will appear in the bore. This will turn to red rust if not removed, and the barrel will then require repeated cleanings with flannelette and with gauze, for a time that will vary according to climatic conditions and the state of the bore.
- (b) *Superficial Fouling*.—This is readily removed when warm by the use of a cleaning-rod and flannelette, but if it is allowed to remain long in the barrel it will become hard, and will have a corrosive effect equal to that produced by internal fouling.
- (c) *Metallic Fouling*.—This is removed by the use of the double-pull-through, or by King’s Norton Nickel Solvent.

### (8) Daily Cleaning.

The outside of the gun should be cleaned daily, all parts of the mechanism being wiped with an oily rag. The bore should always be left oily.

To clean the mechanism, a mixture of equal parts of oil, lubricating. G.S., and paraffin should be used. If any parts are clogged with dried oil, spirits of turpentine should be used to remove it. After each part is cleaned, it should be thoroughly dried and slightly oiled.

Hanging the lock and moving the recoiling portions by working the crank handle affords a ready means of oiling the recoiling portions and the bearing parts of the barrel, *i.e.*, just in front of the trunnion block (which can be got at by removing the feed block), and, at the muzzle end, in front of the packing gland.

When paraffin has been used, all traces of it should be thoroughly removed, for paraffin, though an efficient agent for removing rust, does not prevent its formation.

#### *How Taught.*

- (a) *Demonstration* :  
 Cleaning of exterior.  
 Hanging lock.  
 Oiling of working parts.



- (b) *Explanation :*  
Removal of clogged or dried oil.  
Drying after cleaning.  
Amount of lubricating oil used after cleaning.
- (c) *Squad Practice.*
- (d) *Interrogation.*

### (9) Weekly Cleaning.

The gun should be thoroughly overhauled and cleaned each week. The oil should be removed from the bore, and replaced by fresh oil. In cases where the bore has once become rusty, it should be wiped out with flannelette, and then cleaned with the gauze on the pull-through.

### (10) How to use the Steel Cleaning-Rod.

The steel cleaning-rod is used in conjunction with flannelette (as issued) for cleaning and oiling the barrel. The method of procedure is as follows :—

Tear off a strip of flannelette about 4 in. by 2 in., and oil it thoroughly, afterwards working the oil well into the flannelette by kneading it with the fingers. Fold the flannelette longitudinally into four, and insert it into the eyelet of the rod. Unfold the ends of the flannelette, and arrange them about the ends of the rod so that the metal is entirely surrounded. Insert the cleaning-rod into the muzzle end of the barrel, and fix the movable bush so that the muzzle is protected. Work the rod forwards and backwards centrally with the axis of the bore. Remove the oily flannelette ; replace it with a dry piece of the same size, and insert into the barrel as before. The cleaning processes should be continued until the bore is clean and dry. Unless there is internal or metallic fouling present, the barrel is now ready for oiling. For this, the cleaning-rod should be employed as before, a slightly smaller strip of flannelette being used.

*Notes.*—(1) If, during the cleaning process, it should be found difficult to withdraw the rod from the barrel, no cross strain should be used, or the rod will snap. (2) Flannelette used for cleaning purposes need not be thrown away ; if washed it is again quite serviceable.

### *Method of Instruction.*

- (a) *Demonstration :*  
The instructor strips the gun as necessary, and illustrates the use of the cleaning-rod, observing the points laid down above.
- (b) *Explanation :*  
Reason for size of strip of flannelette.  
Need for working oil into flannelette.  
Why flannelette is folded round metal.  
Why rod is put in at muzzle end.  
Use of movable bush.  
Danger of using cross strain.  
Necessity for thoroughly drying bore.  
Why barrel is left oily.
- (c) *Squad Practice.*
- (d) *Interrogation.*



## 11. How to put on a Gauze.

Wire gauze in pieces  $2\frac{1}{2}$  inches by  $1\frac{1}{2}$  inches is supplied, and should be used for the removal of hard fouling or of rust. In attaching it to the pull-through, the following principles should be applied:—

In attaching the gauze to the pull-through, turn the shorter sides towards each other, so that the longer sides take the form "S." Open the loop of the pull-through, and put one side of it in each loop of the "S." Then coil each half of the gauze tightly round the portion of the cord over which it is placed, till the two rolls thus formed, meet.

The object of the gauze is mainly to scour out the grooves, and it should, therefore, fit the bore tightly. When it fails to do this, it should be partially unrolled and packed with paper or flannelette, to increase its bulk.

Grit must be removed from the gauze and pull-through before use, and the gauze should be thoroughly oiled.

Cleaning with gauze entails wear of the bore. Gauze should, therefore, not be pulled through the barrel more often than is laid down here, without sufficient cause. The surest way of preventing the necessity of the continued use of gauze is to keep the bore well oiled so as to prevent rust.

A barrel which has once become rusty will always be more liable to rust than one which has been kept in good condition. It will, therefore, require more attention, and more frequent cleaning with gauze. Similarly, a barrel in which corrosion has commenced will require more care than one of which the surface has not been attacked, for, the corroded portion being rough, moisture is more likely to collect on it and form rust. It is also more difficult to remove rust thoroughly from a rough surface than from a smooth one.

### *Method of Instruction.*

#### (a) *Demonstration :*

The instructor shows how to put on a piece of wire gauze, observing the points laid down above.

#### (b) *Explanation :*

Method of folding gauze into "S" shape.

Insertion of gauze into loop of pull-through.

Reason for rolling gauze in manner laid down.

Object of the gauze.

How to pack it if too small for the bore.

Reason for removal of grit.

Why gauze is oiled.

Danger of excessive use of gauze, and how to avoid necessity of using it.

#### (c) *Squad Practice.*

#### (d) *Interrogation.*

## (12) How to use the Double Pull-through.

Place gunmetal protector on muzzle to keep cord central. Fix the barrel in a vice, or have it held firmly by one man, while two others,



helping with their free hands to keep the barrel steady, pull the cord backwards and forwards until the fouling or rust is loosened. When the gauze is worn out, it should be replaced by one of the spare pieces which are issued with each double pull-through.

*Note.*—With the Perivale barrel holder, only two men are needed.

When signs of wear appear, a new cord should be taken into use, to avoid the risk of the pull-through breaking in the bore. If a breakage does occur, the barrel must be taken at once to the armorer. No attempt should be made by the gunner to remove the obstruction.

(a) *Demonstration* (with the assistance of a squad).

(b) *Explanation* :

Removal of barrel necessary.

Fixing on of muzzle protector.

How pull-through is inserted.

How barrel is held steady.

Necessity of pulling cord centrally with axis of bore : and neglect of this.

Subsequent cleaning, with rod and flannelette.

Use of muzzle protector.

(c) *Squad Practice.*

(d) *Interrogation.*

### (13.) **Cleaning with Boiling Water.**

An effective means of cleaning the bore, whether firing has taken place or not, is found in the use of boiling water. Before this is used, superficial fouling and grease should be cleared away, the barrel being first removed from the gun. About five or six pints should be poured through the bore from the breech, a funnel being used for the purpose. The bore should then be thoroughly dried and oiled. Not only does the boiling water remove the fouling, but the expansion of the metal, due to the heat of the water, loosens any rust there may be, and makes it easily removable.

#### *Method of Teaching.*

(a) *Demonstration* :

Barrel removed from gun.

Grease and fouling cleaned away.

Boiling water poured through barrel by means of funnel.

Barrel dried and re-oiled.

(b) *Explanation* :

Necessity of first cleaning barrel.

Effect of boiling water on metal.

Amount of water used.

Necessity of drying and re-oiling.

Effect of the process on rust.

(c) *Squad Practice.*

(d) *Interrogation.*

### (14.) **Oils.**

The oil used in the R.A.F. for aerial guns is known as P. 924, and is an anti-freezing oil. The test for this oil is that it should remain fluid at a temperature of -40 deg. Centigrade (or -40 Fahrenheit).



With the *aerial* Vickers Gun, P. 924 should be used for *lubricating* purposes at all times—except on rare occasions in hot weather, when a mixture of equal parts of G.S. oil and P. 924 may be used.

In oiling the gun as a *preservative* after it has been cleaned, G.S. oil should be used except in the case of guns constantly in use in machines.

**With the ground gun, and guns used only for instructional purposes on the ground, G.S. oil alone should be used.**

### **(15.) Care and Cleaning of Speeded-up Vickers Guns.**

Generally speaking, the speeding-up of the Vickers Gun tends to bring out any faults that may already exist and care must be taken therefore to maintain the gun in as efficient working condition as possible.

- (a) The .05 washer should not be used.
- (b) The fusee spring should be set at a tension of about 11 lbs.
- (c) The buffer spring and the muzzle cylinder tend to foul after about 600 rounds. No oil, therefore, should be put on them, and they should be very carefully examined after each flight.
- (d) The top pawls must be set down to the correct amount in order to avoid failures in feed. This correct amount may be measured by inserting the body of the "T" fixing pin through the opening on the right side of the feed block. The lower edge of the feed pawls should just touch the "T" fixing pin.
- (e) If pawl springs are found to be weak, trouble in feed is likely to occur. Only good springs, therefore, should be used.
- (f) Only right slides which are up to the correct drawing standard should be used.
- (g) Fusee springs made of hard drawn wire are liable to lose tension gradually, and eventually to fail. They should be tested frequently, therefore, to see that they are up to the proper strength.

## **VI. IMMEDIATE ACTION.**

### **Definition.**

Immediate action is the immediate application of a probable remedy for a stoppage, based on the position of the crank handle.

### **General Remarks.**

(1) During teaching, guns must be set up to simulate the conditions resulting from the particular stoppage under consideration. This should be done by the instructor, without detail.

(2) The position of the crank handle will act as an indication of the immediate action that is necessary to remedy any particular stoppage. For instructional purposes this position may be looked upon as 1st, 2nd, 3rd or 4th.

(3) The instructor must not deal with the causes of stoppages during the first stages of the teaching in immediate action.



(4) As proficiency is attained, the training should be carried out with the firer blindfolded.

(5) Immediate action must not be considered complete until the gun has been relayed and fired.

The instructor should lay stress on the importance of sighting the gun on the target. For this purpose a model aeroplane is found suitable.

It is essential that all kit necessary for the instruction should be prepared before the commencement of the lesson.

### **Kit Required.**

- Gun on mounting, or fuselage.
- Links.
- Dummy cartridges (prepared).
- Loading-handle.
- Crank Handle Retaining Catch and Jam Clearing Tool (Single-handed method).
- Clearing-plug.
- Spare lock.
- Covering for crank handle.

### **Method of Instruction.**

- (1) Give definition, and show the importance of immediate action.
- (2) Demonstrate the four positions of the crank handle.
- (3) Teach thoroughly each position as follows :—
  - (a) Instructor prepares gun and demonstrates immediate action of 1st position.
  - (b) Instructor prepares gun and explains immediate action of 1st position.
    - Pull back crank handle on to roller.
    - Let go.
    - Relay.
    - Fire.
  - (c) Each member of the class now performs immediate action, and the instructor criticises.
  - (d) Instructor questions class.

*Note.*—Only when the class is proficient should the instructor go on to the next phase of the teaching. Exactly the same method and sequence as is given above must be adhered to throughout the whole of the instruction.

A cloth should be used to cover up the crank handle, and removed only when the firer is in position for firing. It is unnecessary to say "Gun stops." If it be required to represent the recurrence of a stoppage, the instructor will proceed to carry out the necessary actions.

### **Explanation of Immediate Action Table.**

The following table of temporary stoppages, set out in five columns, gives a clear indication of the methods to be employed in teaching.



*Column 1* shows the four positions of the crank handle when the gun stops firing. The first three positions may vary slightly. The position of the handle affords a ready indication of the correct immediate action in each case, and must be clearly recognised before the instruction proceeds.

*Column 2* gives a detailed description of the immediate action to be performed by the firer.

*Column 3* deals with the probable cause of the stoppages, but it is of the first importance that the instructor does not proceed to this stage until every immediate action can be correctly carried out without the slightest hesitation.

*Column 4* gives the method of preventing the occurrence of certain stoppages. They can generally be avoided by a careful examination and preparation of the gun before a flight.

*Column 5* shows how the various temporary stoppages can be simulated for instructional purposes. It is unnecessary to teach these methods of preparation to every pupil, but instructors (and men being trained as instructors) must have a thorough knowledge of this column in order to teach the correct immediate action.

As pupils at this stage have a thorough knowledge of the mechanism of the gun, it should be unnecessary to go into details of mechanism during the teaching of immediate action. This table has therefore been abbreviated accordingly.

### **Table of Immediate Action.**

There are two recognised methods of remedying stoppages :—

- (a) The Single-handed Method.
- (b) The Double-handed Method.

In the Single-handed Method the gunner must always have one hand or the other on the aeroplane control lever, so that only one hand is free to carry out the necessary actions. In order to render this possible, some form of Crank Handle Retaining Catch is necessary to hold back the crank handle in the vertical position while the gunner is clearing the face of the lock or removing a round from the feed block.

In the Double-handed Method the gunner may use both hands, the aeroplane control lever being held meanwhile between his knees.

The Table set out below gives the details for both methods. The actions marked \* should be omitted where both hands are used.



Position of Crank Handle.	Immediate Action.	Probable Cause.	Prevention of Occurrence.	Method of Preparation for Instructional purposes.
First.	<p>A. Pull back crank handle on to roller. Let go. <b>Relay.</b> <b>Fire.</b></p> <p>B. If failure recurs, repeat A till gun is warm.</p> <p>C. Stoppages arising from causes given in this group cannot be remedied in the air.</p>	<p>A. (1) Defective ammunition—Weak charge. Deteriorated ammunition. (2) Tight packing in links.</p> <p>B. Excessive friction, due to congealed oil.</p> <p>C. (1) Strong fusee spring. (2) Worn barrel. (3) Friction on working parts.</p>	<p>A. (1) Cannot be provided against.</p> <p>(2) Correct gauging of ammunition and links.</p> <p>B. Fire occasional bursts.</p> <p>C. A high standard of training of arm-ourers and gun-ners should prevent these from occurring.</p>	<p><i>Off Range</i> :— A. Insert belt in feed block. Half load. Hang lock. Push belt into correct position in feed block.</p> <p>B. Hang lock. Push belt into correct position in feed block.</p> <p><i>On Range</i> :— Increase weight of fusee spring</p>
Second.	<p>A. Raise rear cover. Draw back crank handle. *Engage retaining catch. Clear face of extractor with butt end of clearing-plug. Close rear cover. Release crank handle* from retaining catch. Half load.</p>	<p>(1) Separated case, due to insufficient support of lock on base of cartridge. The front portion of the cartridge case is telescoped on to next cartridge.</p> <p>(2) Bulged cartridge.</p> <p><i>Note</i>.—This is impossible with the Prideaux link.</p>	<p>(1) Careful gauging of length of connecting rod before flight.</p> <p>(2) Careful inspection and testing of ammunition before flight.</p>	<p><i>Off Range</i> :— Insert belt in feed block. Raise cover. Lift lock. Place dummy cartridge (with separated case securely telescoped on its shoulder) between projections of gib. Replace lock. Lower rear cover.</p>



Position of Crank Handle.	Immediate Action.	Probable Cause.	Prevention of Occurrence.	Method of Preparation for Instructional purposes.
	<b>Relay.</b> Fire. B. If failure recurs, the clearing-plug must be used.	B. Separated case, the front portion of which is left in the chamber.	B. As for A.	Let go crank handle. Push belt into correct position in feed block. <i>Note.</i> —The only certain way to set up this stoppage is to use a dummy with a front portion of a separated case soldered on it. <b>On Range.</b> — File a cartridge about 1 inch from the base, and insert in the belt. Care must be taken that the cartridge is not filed too far through, as there is danger of the bullet being left in the barrel.
Third.	A. Strike down crank handle. <b>Relay.</b> Fire. (Should stoppage recur, repeat this immediate action till gun is warm.)  B. If A fails :— Raise crank handle* and engage retaining catch. Push belt into correct position in feed block.	A. (1) Excessive friction, due to congealed oil. (2) Friction on lock, obstructing upward movement of extractor  B. (1) Slight cross feed. (2) Slightly misshapen link.	A. (1) Fire occasional short burst during flight, while not in action. (2) High standard of training of armourers (inspection of lock). B. (1) Correct loading action. (2) Inspection of links while filling belts.	<b>Off Range.</b> — A. Insert belt in feed block. Fully load, using loading handle, easing it on second motion so as to leave crank handle in third position.  B. Insert belt in feed block. Half load. Hang lock. Raise rear cover. Push next round halfway into position in feed block. Close cover.



Position of Crank Handle.	Immediate Action.	Probable Cause.	Prevention of Occurrence.	Method of Preparation for Instructional purposes.
	<p>*Disengage retaining catch. Strike down crank handle.</p> <p><b>Relay.</b> Fire.</p> <p>C. If A and B fail, and pawls of feed block are protruding :—</p> <p>*Draw back crank handle and engage retaining catch.</p> <p>*Raise rear cover.</p> <p>*Clear face of extractor.</p> <p>*Remove first round in feed block, using jam clearer.</p> <p>*Close rear cover.</p> <p>*Release crank handle from retaining catch.</p> <p>*Half load.</p> <p><b>*Relay.</b> *Fire.</p> <p><i>Double-handed Method :—</i></p> <p>Work loading-handle to full extent.</p> <p>Depress top pawls, and, keeping pawls depressed, let go of loading-handle.</p> <p>Release top pawls.</p> <p>Half load.</p> <p><b>Relay.</b> Fire.</p>	<p>C. Double feed, due to bad loading.</p>	<p>C. High standard of training in loading gun.</p>	<p>Let crank handle go slowly forward, and tap lightly.</p> <p>C. As for A.</p> <p>C. Insert belt in feed block.</p> <p>Half load.</p> <p>Hang lock.</p> <p>Draw back recoiling portions twice.</p> <p>Let crank handle go forward.</p> <p>53</p> <p><i>On Range :—</i></p> <p>A. Set up as in "Off range."</p> <p>B. Use a belt filled in a slightly incorrect manner, or bend a link.</p> <p>C. Set up as in C above.</p>



Position of Crank Handle.	Immediate Action.	Probable Cause.	Prevention of Occurrence.	Method of Preparation for Instructional purposes.
Fourth.	<p>A. Half load. <b>Relay.</b> Fire.</p> <p>B. If A fails :— Unload. lock. Change lock. Reload. <b>Relay.</b> Fire.</p> <p><i>Note.</i>—When using a CC gear, a No. 4 stoppage may occur owing to lack of pressure in reservoir. I.A. would be to pull up reservoir handle and let go.</p>	<p>A. Misfire (defective ammunition).</p> <p>B. (1) Damaged or broken firing-pin. (2) Broken lock spring.</p>	<p>A. } No means of detection. B. }</p>	<p><i>Off Range.</i> :— A. Fully load. <b>Press thumb-piece.</b></p> <p>B. As for A. Instructor states "Gun does not fire."</p> <p><i>On Range.</i> :— A. Insert dummy cartridge in belt. B. Insert two dummy cartridges in the belt in succession.</p>



The following would cause prolonged stoppages :—

- (1) Loose or broken muzzle cup.
- (2) Broken gib or gib-spring.
- (3) Broken fusee or fusee spring.

In the event of these stoppages, the firer would be compelled to break off the fight.

The following causes might bring about a run-away gun :—

- (1) Broken nose of trigger.
- (2) Broken bent of tumbler.

In the event of these happening, the gun would fire automatically, without being controlled by the gear. The remedy would be to ease down the loading-handle slightly. This would stop the gun from firing, since the front portion of the handle comes in contact with the crank handle, thus giving a No. 3 stoppage. Where the loading-handle is not fitted, it would be necessary to open the ammunition chute, force the jamb clearer between two cartridges in the belt, and so stop the gun.

Note :—*Immediate Action on the Range.*

When instruction in Immediate Action is being carried out on the range, it is important that the firer should be seated in the same position as when in an aeroplane. Dummy nacelles, representing various types of machine should therefore be constructed.

The object of this is to accustom the firer to manipulating the loading-handle, aligning the sights on a mark, and applying the correct Immediate Action, from exactly the same position as he would occupy in a machine.

## VII.—INSTRUCTION IN CAUSES OF STOPPAGES AND SETTING UP GUN.

Before this subject is attempted, the students must have a thorough knowledge of mechanism, and must know how to apply the correct Immediate Action in the event of a stoppage. The instruction should then proceed on the following lines :—

### (a) *Demonstration :*

Instructor sets up gun to represent a particular stoppage.

*Example :* First position, Column 5, Table of Immediate Action. After setting up gun, instructor raises rear cover.

### (b) *Explanation :*

One round on face of extractor, the empty case having fallen off. The horns of the extractor are engaged on the steps of the cams. The lock has been taken forward by the fusee spring before the horns of the extractor have been able to clear the cams.

*Note.*—The remedy to be applied in the event of this stoppage has already been taught, and only needs to be applied, without detail.



(c) *Squad Practice :*

Each member of the class sets up the stoppage, and explains what his actions represent.

(d) *Interrogation :*

Each step in the preparation of stoppages, given in Column 2. Table of Immediate Action, should be taken in turn, the method and sequence shown above being adhered to throughout the teaching.

### VIII.—POINTS TO BE OBSERVED BEFORE, DURING, AND AFTER A FLIGHT OR RANGE PRACTICES.

Points marked \* are applicable only to Flight.

*Before Flight (or Range Practices).*—To be carried out under the supervision of the Gunnery Officer :—

1. **See that the sliding shutter is drawn back.**
  2. **See that the barrel casing is filled with water.** (The casing holds about 7 pints. In places where the temperature is likely to fall much below freezing-point, 5 pints only of water should be used, together with 25 per cent. of glycerine).
  3. **Replace the filling-hole plug, and pull out the steam escape tube.**
  4. See that the barrel is clean and dry.
  5. Oil the frictional parts lightly with P. 924 in winter, and a mixture of G.S. oil and P. 924 in summer.
- Note.*—On the ground G.S. oil only should be used.
6. Weight the recoiling portions (for method, see section on “Repairs and Adjustments”). The gun must be in a horizontal position, and the recoiling portions should not weigh more than 2 lbs.
  7. Weigh the fusee spring (for method, see section on “Repairs and Adjustments”). The tension of the fusee spring should be such as to obtain the maximum fire efficiency of the gun, viz., 600 rounds per minute. This tension should, however, not exceed 12 lbs.
  8. Inspect the muzzle attachment. The disc should be clean and bright. The .05 washer should be in position, and the muzzle cup clean and screwed on tightly.

*Note.*—Where the Conversion Set is fitted to the gun, the .05 washer should not be used.

9. See that the gun is accurately fixed upon its mounting.
- \*10. Examine ammunition chutes and box, to see that they are correctly fitted.
11. See that the link-belts are correctly prepared and placed correctly in the ammunition box.
12. See that the sights are properly harmonised.
13. Make sure that the loading-handle is correctly fitted, and not hindering the movement of the crank handle.
14. Check tools and spare parts.



- \*15. See that the first round is engaged in front of the bottom pawls
- 16. Test the fitting and timing of the gear.
- \*17. If facilities allow, fire short bursts on the range.  
*Note.*—Since the gun is only air-cooled, it must only be fired in short bursts on the ground, time being allowed for cooling between the bursts.

*During Flight (or Range Practices) :—*

- 1. **See that a sufficient supply of water is kept in the barrel casing.**  
 (The water begins to boil after 600 rounds fired with maximum rapidity. Afterwards, if the firing is continued, the water evaporates at the rate of  $1\frac{1}{2}$  pints for every 1,000 rounds).
- \*2. Fire occasional short bursts to prevent the working parts from becoming clogged by congealed oil.
- \*3. The gun should be unloaded before landing.

*After Flight (or Range Practices).*—To be carried out under the supervision of the Gunnery Officer :—

- 1. See that the gun has been correctly unloaded.
- 2. See that the tension of the lockspring has been eased.
- 3. **Empty the barrel casing, and see that all plugs are replaced.**
- 4. If possible, remove recoiling portions and take them to the armoury, where they should be thoroughly cleaned, and then re-oiled.
- 5. Clean the non-recoiling portions, removing clogged oil by means of spirits of turpentine. Then re-oil.
- 6. Refill the ammunition box. All unused ammunition must be re-tested.
- \*7. Examine chutes, to see that they are not damaged or displaced.
- 8. Examine sights to see that they are not damaged.
- \*9. Enquire of pilot if stoppages have occurred, or if any defects have been apparent in the action of the gun. Such defects should be noted and remedied immediately.
- 10. Fill up the history sheet.

## IX. EXAMINATION OF GUN.

- (1) Kit required for Teaching.
- (2) General remarks.
- (3) Muzzle Attachment (Outer Casing).
- (4) Muzzle Cup.
- (5) Ring Sight.
- (6) **Steam Tube.**
- (7) Bead Sight.
- (8) Rear Cover Lock.
- (9) **Safety Catch.**
- (10) **Firing Lever.**
- (11) **Trigger Bar and Spring.**
- (12) Fusee Spring and Fusee.
- (13) Recoiling Portions.
- (14) Connecting Rod.



- (15) Lock.
- (16) **Sliding Shutter.**
- (17) Barrels.
- (18) Packing.
- (19) Axis Pins, etc.
- (20) Spare Parts.
- (21) Links.

### (1) **Kit required for Teaching.**

Gun and Mounting.  
Spare parts complete.  
Spare Barrel.  
Links.

### (2) **General Remarks.**

It is important that not only should machine guns be examined when first taken over, but frequent examinations of guns and mountings are also necessary. The gun should be examined daily, as stated in "Care and Cleaning," and a more detailed examination should be made occasionally, as required.

The method and sequence of instruction will be the same as for all other subjects, whenever the sub-head under treatment with permits. The work will therefore take the form of:—

- (a) *Demonstration.*
- (b) *Explanation.*
- (c) *Squad Practice.*
- (d) *Interrogation.*

### (3) **Muzzle Attachment (Outer Casing).**

- (a) See that the disc is in good condition and clean.
- (b) See that it is free from burrs and fouling.

### (4) **Muzzle Cup.**

- (a) This should be clean and free from rust.
- (b) See that the thread is not burred.
- (c) See that there are no signs of flaws.
- (d) See that the .05 washer is in correctly. (This does not apply to the Speeded-up Gun).

### (5) **Ring Sight.**

- (a) See that this is firmly fixed, and in correct position with regard to eye.
- (b) See that it is not distorted.

### (6) **Steam Tube.**

- (a) See that the keeper screw is in the correct position.
- (b) See that the slide valve moves freely. This can be ascertained by giving the gun a rocking motion, when the movement of the valve should be distinctly heard.



**(7) Bead Sight.**

- (a) See that this is firmly fixed.
- (b) See that it is correct in height.

**(8) Rear Cover Lock.**

- (a) The rear cover should fasten automatically when lowered.
- (b) The cover lock screwed axis pin should be fully screwed home.

**(9) Safety Catch.**

- (a) See that spring and catch work automatically.

**(10) Firing Lever.**

- (a) See that the firing lever cannot be pressed home unless the safety catch is raised.
- (b) See that the trigger is released before the firing lever bears against the stop on the safety catch, when the latter is raised.

**(11) Trigger Bar and Spring.**

- (a) The trigger bar spring should be tested to see that it sends the trigger bar quickly forward. (This can be done by hand.)
- (b) Inspect trigger bar for roughness and burrs.

**(12) Fusee Spring and Fusee.**

- (a) See that the claws of the spring are in good condition.
- (b) See that the threads of the adjusting screw are in good order.
- (c) See that the vice pin is not bent.
- (d) Test the weight. (To weigh and adjust, see "Repairs and Adjustments.")
- (e) See that the fusee and chain are in good condition.

**(13) Recoiling Portions.**

(a) Remove the fusee spring and work the recoiling portions backwards and forwards. If they move freely, they are correct. (For method of weighing, see "Repairs and Adjustments.") If not, look for the following :—

- (i) Too tight packing.
- (ii) Dented side of breech casing and consequent bearing on inside plates.
- (iii) Slightly bent or damaged inside plates.

**(14) Connecting Rod.**

Examine as detailed in "Repairs and Adjustments."

**(15) Lock.****A. Side and Extractor Levers :**

- (a) Remove feed block, and keep front cover raised.
- (b) Draw back crank handle, and let it go slowly forward on to check lever.



- (c) If correct, there should be no vertical play, when the extractor is manipulated by hand, after the lock is home.

B. *Bents of Sear and Firing Pin :*

- (a) Pull crank handle on to roller.
- (b) **Press thumb piece, and, while maintaining pressure, let crank handle go slowly forward on to check lever.**
- (c) The extractor should be up at its highest point before the sear releases the firing pin.

C. *Extractor :*

- (a) Remove lock.
- (b) Examine face of extractor for burrs and flaws.
- (c) Try grooves with armourer's dummy, to see if cartridge would be held horizontally.
- (d) Test gib and spring.

D. *Nose of Trigger and Bent of Tumbler :*

- (a) Fully cock lock.
- (b) Release sear ; the firing-pin should be held back.

E. *Firing-Pin :*

- (a) See that the point is not broken.

A broken firing-pin can be recognised, without stripping the lock, by releasing the lock spring, with the extractor up. If correct, the firing-pin will then protrude from the firing-pin hole, and can be withdrawn by raising the tail of the tumbler. If it does not protrude, or, if protruding, its point is not withdrawn when the tail of the tumbler is raised, some part of the firing-pin is broken.

*Note.*—This should be done with the extractor in a vertical position.

F. *Lock Spring :* Test the weight as follows :—

- (a) Fully cock lock.
- (b) Place bottom of lock on a flat surface.
- (c) Place loop spring balance over side lever head, and left hand on the top of the lock.
- (d) Draw side lever head upwards with spring balance ; when tumbler commences to move, the spring should record 14 lbs.

### (16) Sliding Shutter.

(a) **The sliding shutter should not require any undue effort to move it by hand. If it does, look for :—**

- (i) **Dirt or Grit.**
- (ii) **Dented bottom plate, probably due to the dropping of the connecting rod on to it when the lock is out of the gun.**
- (b) **See that the catch and spring work automatically.**

### (17) Barrels.

For daily examination, use of the mirror reflector is sufficient, but the only certain way is to carefully examine the barrel with the naked eye. The barrel should be closely inspected for rust, cuts, erosion, nickelling, cord wear and bulges. Proceed as follows :—

- (a) Remove barrel from gun.



- (b) Put the breech end close to the eye, and move the barrel with a slightly circular movement.
- (c) Put the breech end about 10 inches from the eye, and move the barrel with a slightly circular movement.
- (d) Reverse the barrel, and examine carefully from the muzzle end in a similar manner.
- (e) See that the threads on the barrel are not burred.

*Note.*—The spare barrel also should be examined in the manner described.

### (18) Packing.

**The barrel bearings should be packed so that there is no leakage when the barrel casing is filled with water.**

(N.B.—This package is just as necessary in aerial as in ground guns).

### (19) Axis Pins, etc.

See that all axis pins are correct, also chains securing component parts.

### (20) Spare Parts.

- (a) See that they are correct as regards number and condition.
- (b) See that they are clean and free from rust.

### (21) Links.

- (a) See that these are correct in shape.

## X.—REPAIRS AND ADJUSTMENTS.

- (1) Kit required.
- (2) General remarks.
- (3) Instructions for fitting a new disc to the muzzle attachment.
- (4) Instructions for weighing and adjusting the fusee spring.
- (5) Instructions for weighing the recoiling portions.
- (6) Instructions for testing and adjusting the length of the connecting-rod.
- (7) Instructions for the renewal of packing.
- (8) Instructions for various repairs to the lock.

### (1) Kit Required.

- (a) Gun and tripod.
- (b) Spare parts box and case complete.

### (2) General Remarks.

(a) It is necessary that all machine gunners should be able to carry out any of the minor repairs enumerated here.

(b) Whenever possible, the subject must be taught in the same method and sequence as is laid down for the teaching of other subjects.



### (3) Instructions for Fitting a New Disc to the Muzzle Attachment.

Unscrew the front cone.

Cut the front bevel of the disc, driving sufficient metal up to provide a hold for the pliers.

Remove the disc, and replace it with a new one.

When assembling a new disc, it may be necessary to tap it lightly, to ensure a permanent fit.

### (4) Instructions for Weighing and Adjusting the Fusee Spring.

Take out the lock.

Place the loop of the spring balance over the knob of the crank handle.

Standing on the left side of the gun, press down the check lever with the left hand.

Pull the balance vertically upwards, resting the wrist on the breech casing.

The reading indicated when the crank handle commences to move will be the weight of the fusee spring.

The tension of the fusee spring should be such as to obtain the maximum fire efficiency of the gun. This tension should, however, not exceed 12 lbs.

If the spring is over, or not up to weight, adjust by means of the vice pin. Generally six clicks (three revolutions) make a difference of about 1 lb. Turning the vice pin in the direction of the hands of a watch decreases the weight, and *vice versa*.

### (5) Instructions for Weighing the Recoiling Portions.

Remove fusee spring.

Place crank handle nearly vertical.

Place loop of spring balance over boss of crank handle, and pull slowly to the rear.

For aerial purposes the weight should not exceed 2 lbs.

### (6) Instructions for Testing the Length of the Connecting Rod.

Remove fusee spring.

Raise rear cover and pull crank handle on to roller.

Insert on extractor, opposite firing-pin hole, an armourer's dummy, placing it into position through the opening in the underside of the breech casing.

Lift extractor up to its highest point.

See that the barrel is home.

Turn crank handle towards check lever.

Guide armourer's dummy into chamber.

Push check lever back just clear of crank handle, and let crank handle gently down towards rest.

If connecting rod is of correct length, a check will be felt just before crank handle reaches check lever. If no check is felt, the lock is not



fully home (*i.e.*, the connecting rod is not long enough). In this case it must be lengthened in accordance with instructions given below.

### **Instructions for Adjusting the Length of the Connecting Rod.**

Remove fusee spring.

Take out lock.

Determine the number of No. 1 or No. 2 washers (or both) required, to correct the length of the connecting rod, by first placing a No. 1 on the outer face of the adjusting nut on the connecting rod, replacing the lock and re-testing the length, adding washers and again re-testing as may be necessary. When the correct length has been determined, the washers which have been placed on the outer face of the adjusting nut must be assembled permanently on the shoulder of the connecting rod and secured by the nut. To do this, turn the connecting rod back **on to the trigger bar lever**, unscrew the adjusting nut with the combination tool, and remove it. Place the washers on the connecting rod and screw the adjusting nut tightly home on the washers. Re-test to ensure that the adjustment is correct.

*Note.*—Two sizes of washers, .003 and .005 of an inch are issued, to enable the connecting rod to be adjusted finely. The No. 1 .003-inch washer has one hole punched in the rim, and the No. 2 .005-inch washer has two holes in the rim. By the use of these sizes in combination, the following adjustments, 3, 5, 6, 8, 9 and 10 thousandths of an inch can be made. The adjustment is commonly made with the two washers together. This is sufficient as a purely temporary measure, but a finer adjustment might subsequently be made. It is not necessary for any mechanical reason for the two washers always to be used together.

### **(7) Instructions for the Renewal of Packing.**

#### **(a) *At the Breech End of the Barrel :***

Strip the gun and take the recoiling portions out.

Wind a strand of asbestos (part of a 5 yards piece) in the cannellure of the barrel, pressing it together with a thin piece of wood or the point of a screwdriver or knife, until the cannellure is full.

Smooth down flush with the barrel.

Oil the asbestos.

Re-assemble parts.

#### **(b) *At the Muzzle End of the Barrel :***

Remove the muzzle attachment outer casing.

Unscrew muzzle cup.

Unscrew the gland, and repack, or (if necessary) replace the asbestos, having first oiled it, by winding it loosely round the barrel ; whilst winding, push it in with a No. 3 punch, a piece of wood, or any blunt-ended instrument which will fit.

Screw on the gland as tightly as can be done by hand.

Hang the lock.



Work the recoiling portions backwards and forwards to ensure that they move freely.

If the packing is found to bear too hard on the barrel, the gland should be removed and one or two strands taken out of the asbestos.

### **(8) Instructions for Various Repairs to the Lock.**

The lock should be stripped (in accordance with instructions already laid down) until the faulty part is reached, when it should be replaced, and the lock assembled as detailed.

## **XI.—SPARE PARTS.**

### **General Remarks.**

- (1) It is essential to know where to find any spare part that may be required.
- (2) All spare parts must be called by their proper names, and the use of fancy names (*e.g.*, butterfly spring) is forbidden.
- (3) A list of deficiencies should be kept inside each box.
- (4) Spare parts must be kept slightly oiled.
- (5) Spare parts should be inspected weekly by the Gunnery Officer.
- (6) All deficiencies should be reported at once.

### **Method of Instruction.**

#### *First Lesson.*

*Object of Lesson :* To teach the correct names of spare parts.

The instructor, having laid out on a table or waterproof sheet the whole of the contents of the spare parts box, spare parts case and wallet, will teach his squad as follows :—

#### *(a) Demonstration :*

Instructor holds up each article in turn (in accordance with the official list of spare parts), and tells squad the correct name given to it.

#### *(b) Explanation :*

The use of the part under consideration is taught.

#### *(c) Squad Practice :*

When all spare parts have been named and explained by the instructor, the members of the class recapitulate the names and uses in a similar manner.

#### *(d) Interrogation.*

#### *Second Lesson.*

*Object of Lesson :* To teach the proper method of packing spare parts.

#### *(a) Demonstration :*

Instructor exhibits to the squad the spare parts box, and spare parts case and wallet, properly packed. He then lays out all parts on table or waterproof sheet, as before.



(b) *Explanation :*

Instructor teaches the number of each particular spare part that is issued per 2 guns, and explains where they are kept, and the method of packing them into the spare parts box, spare parts case or wallet.

(c) *Squad Practice :*

All the spare parts are again laid out as already described, and members of the squad recapitulate in a similar manner.

(d) *Interrogation :*

Instructor questions squad as to where spare parts are carried, number carried, how packed, &c.

## **XII. TESTING OF AMMUNITION.**

### **Importance of Subject.**

When the vital importance was realised of employing the best possible type of ammunition in the R.A.F. on account of the seriousness of stoppages in the air, it was decided to manufacture special ammunition. This is now done, but for further security every round should be most carefully tested before use.

### **Defects looked for in Ammunition.**

- (1) Cracks round the indents which join the case to the cannellure of the bullet.
- (2) Faulty diameter (bulged round).
- (3) Length of cartridge over or under gauge.
- (4) Thick rim.
- (5) High set cap.
- (6) Deep Set Cap.
- (7) Loose bullet.
- (8) Any unusual feature.

### **Method of Testing.**

This consists of two processes : one visual and the other carried out by means of special apparatus.

The visual process consists of a close examination of the round with a view to detecting defects (1) (5) (6) (7) and (8) above.

The remaining defects can best be made apparent by means of the "Campbell Ammunition Tester."

*Note.*—Before this apparatus is used, the adjustable indicator should be carefully set by means of an armourer's dummy, and fixed in the correct position by means of the locking-nuts.

Where the "Campbell" apparatus is not available for testing purposes, the following plan will be found useful. A new barrel should be sunk into the bench. Near to it should be screwed the extractor of a Vickers gun lock, face upwards and having the gib and gib-spring removed. Above the extractor should be placed an arch gauged to



the standard length of a cartridge. (For teaching purposes, this apparatus may be arranged on a small block of wood). After the cartridge has been inspected with the eye, it should be dropped into the barrel, to test its diameter. It should then be removed, and slipped along the grooves of the extractor to test the rim. This process tests the length of the cartridge at the same time as the rim, and also probably reveals any case of high set cap that may have escaped notice. While the cartridge is being passed through the cartridge grooves, it should be turned round, so that every part of the rim is tested.

If rounds are tested in the manner indicated, the only gun stoppages likely to occur through ammunition are those due to a badly-drawn case or a weak charge, both of which only become apparent when the cartridge is fired.

### **Method of Instruction.**

(a) *Demonstration :*

Instructor exhibits testing apparatus, and shows how to inspect and test a round.

(b) *Explanation :*

The necessity for the careful testing of ammunition.

The various defects looked for, and the manner of testing for them.

How a simple testing apparatus may be made.

(c) *Squad Practice :*

Each member of the squad tests rounds of ammunition, explaining meanwhile the purpose of his actions.

(d) *Interrogation .*

## **XIII. ELECTRICAL HEATERS.**

### *Purpose :*

The electrical heaters are intended to counteract the effect of low atmospheric temperature by maintaining the breech mechanism of the Vickers Gun at a sufficiently high temperature to prevent the lubricant from becoming so viscous as to impede the proper working of the gun.

### *Description :*

Each heating set comprises two heaters. Each heater consists of a nichrome ribbon element wound spirally on a flat mica former, enclosed between sheets of mica, and contained in a case made from sheet copper. The two ends of the nichrome ribbon are connected to two brass terminal screws which pass through the case to the outside of the heater and are used both for making the electrical connections and for fixing one end of the heater to the breech casing of the gun through insulating bushes. An insulating cap is provided to protect the ends of the terminal screws.

A hole is formed in the heater at the opposite end to the screws, to take a copper rivet for fixing this end of the heater to the breech casing of the gun.

A pair of twin flexible electric cables are provided, connected at one end to a standard 2-pin plug socket. The other ends of the



cables terminate in eyelets for connection to the terminal screws on the heaters.

*Fitting :*

The two heaters are designed to be mounted inside the breech casing of the gun, one on each side, below the guides.

Both the heaters are identical and interchangeable. A jig is provided for properly positioning the necessary holes in the breech casing for fixing the heaters.

The jig is to be mounted on the gun, and held in position by the clamping studs and nuts provided for the purpose, while the holes are being drilled. Two  $\frac{1}{4}$  in. holes are required to take the terminals and one  $\frac{3}{32}$  in. hole to take the rivet.

The heater on the right-hand side is mounted in the gun with its terminal screws nearest the barrel, while the heater on the left-hand side is mounted in the reverse direction.

When the heaters are being placed in position, the terminal screws should be passed through the holes in the side plates until the insulating bushes at the base of each screw fill the holes in the side plates. The insulating base pieces should then be slipped over the screws and fixed so as to clamp the heater to the side plate by means of a washer and nut on each screw. The other ends of the heaters should then be secured in position by means of copper rivets. The twin flexible cables attached to the 2-pin plug should be connected to the terminal screws of the heaters, one pair to each heater, and secured by a nut and lock nut. The insulating cap should then be placed in position to cover the terminals and the fixing screws screwed home.

The cables are sufficiently long to allow the 2-pin plug to be taken to the rear of the gun: it should be attached to the gun mounting in any convenient position.

The 2-pin socket should be wired up to the general 12-volt electric supply of the aircraft.

#### **XIV. LIST OF COMPONENT PARTS OF THE GUN.**

##### **Non-Recoiling Portions.**

Barrel Casing :—

Muzzle Attachment.

Outer Casing.

Front Cone.

Gland.

Disc.

**Emptying Hole (with Screwed Plug).**

**Filling Hole (with Screwed Plug).**

**Steam Escape Tube (with Cork Plug).**

Bracket.

Sleeve.

Bottom Plate.

Seating for Ejection.

Louvres.

Barrel Guide.

**Steam Tube (with Sliding Valve).**



## Breech Casing :

Right Outside Plate.

Left Outside Plate.

Right Slide.

Left Slide.

Check Lever.

Check Lever Bracket.

**Elevating Stop.**

Cams.

Roller.

Collar (with Split Pin).

## Front Cover :

Hooks.

Extractor Stop.

Catch.

Catch Lever.

Catch Plunger.

Catch Spring.

Catch Plug.

## Joint Cover Pin.

## Rear Cover :

Ramps.

**Trigger Bar.****Trigger Bar Spring.**

Cover Lock.

Cover Lock Axis Pin.

Cover Lock Spring.

Lock Guides.

## Rear Crosspiece :

Axis Pin.

Traversing Handles.

**Trigger Bar Lever.****Safety Catch.****Safety Catch Axis Pin.****Safety Catch Piston and Spring.****Firing Lever.****Firing Lever Pawl.****Firing Lever Axis Pin.****Firing Lever Thumb-piece.**

## T-Fixing Pin.

## Bottom Plate :

**Sliding Shutter.****Sliding Shutter Catch.**

## Feed Block :

Cartridge Stop.

Bullet Stop.

Bottom Lever.

Top Lever.

Slide.



Top Pawls.  
 Top Pawls Axis Pin.  
 Top Pawls Spring.  
 Bottom Pawls.  
 Bottom Pawls Axis Pin.  
 Bottom Pawls Spring.  
 Cartridge Guides.

Fusee.

Fusee Chain.

Fusee Spring.

Adjusting Screw (with Vice Pin).

Fusee Spring Box.

### Recoiling Portions.

Barrel :

Cannelure.

Block.

Trunnions.

Chamber.

Lead.

Muzzle Cup.

.05 Washer.

Left Side Plate.

Right Side Plate.

Side Plate Springs.

Crank.

Crank Pin.

Crank Shaft.

Connecting Rod.

Crank Handle.

Lock Guides.

Lock :

Casing.

Extractor Stop.

Flanges.

Side Levers.

Side Levers Head.

Extractor Levers.

Trigger.

Trigger Axis Pin.

Tumbler.

Tumbler Axis Pin.

Firing Pin.

Sear.

Sear Spring.

Lock Spring.

Side Levers Axis Bush (with Split Pin).

Extractor.

Cartridge Grooves.



Horns.  
 Gib.  
 Gib Spring.  
 Gib Spring Cover.

### Conversion Set.

Muzzle Cylinder.  
 Buffer Spring.  
 Brass Split Pin.

## XV. TUNING-UP OF GUNS.

Before guns are issued for use in Aircraft, they are overhauled by the R.A.F. Gun Testing Section which is responsible for their satisfactory "running in" and "tuning up." This is with a view to reducing to a minimum trouble in the air.

The work carried out by the Gun Testing Section is on the following lines :—

- (1) All bearing surfaces are carefully polished so as to reduce friction to a minimum.
- (2) Any signs of rubbing are carefully stoned down.
- (3) Approved modifications, not yet incorporated in the manufacture, are carried out.
- (4) Before being sent out as approved, all guns must pass a functioning test with the fusee spring set as low as 4 lbs. and as high as 16 lbs., and also a depression test of 80 deg.
- (5) When guns have passed these tests satisfactorily, the Gun Testing Section mark (2 crossed .303 cartridges) is stamped upon them as follows :—

*Barrel Casing.*—One mark on the front of the barrel casing (immediately under the steam tube hole).

*Crank Shaft.*—One mark on the end of the crankshaft (crank handle end).

*Barrel.*—One mark on the polished side of the barrel trunnion block.

*Note.*—The barrel should always be assembled in the gun so that the polished part of the trunnion block, bearing this mark, is at the bottom. This is very important, as apart from the desirability of keeping the same bearing surfaces together, the slight variations in the trunnion block make several pounds difference in the weight of the recoiling portions, according to the way the barrel is assembled.

All guns bearing these marks have functioned satisfactorily and may be relied upon. Linen labels giving details of the gun and of its tests are attached in each case and should not be detached until the gun has arrived at the squadron which is to use it.

In case of any complaint the full details on the label should be quoted, and the gun returned to the Gun Testing Section—if possible, without any alteration.



## XVI.—ROUNDS COUNTER GEAR FOR VICKERS GUN.

### Purpose.

This device is for attachment to the Vickers Gun, for the purpose of counting the rounds fired.

### Description.

The Rounds Counter is a Veeder apparatus, the principle of which is similar to that of the ordinary cyclometer. It consists of the following parts :—

*Counting Mechanism.*—This is enclosed in a small rectangular box. To the front face of this box is fastened a flange through which two holes are bored at the top and bottom. In the rear face of the box is a glass covered opening through which the figures registered by the counting mechanism may be read. To the right of the box is a projection, bored to accommodate a shaft connected with the internal mechanism. To the end of this shaft is fastened a toothed wheel, having 11 teeth which occupy two-thirds of its circumference, the remaining portion being cut away to accommodate a small set-screw. On the left of the box is another projection, bored to accommodate another shaft connected with the internal mechanism. On the end of this shaft is fastened a milled nut.

*Fixing Block.*—This is a steel bridge-shaped block, by means of which the counting mechanism box is attached to the rear cross-piece of the gun. From front to rear, at its corners, are pierced 4 holes to accommodate the screws which attach it to the rear cross-piece. There are also two smaller holes by which the flange at the front of the counting mechanism box is attached to this block.

*The Cylindrical Box.*—This is threaded externally at the rear to accommodate the hexagonal nut. In front of the threaded portion of the box is a triangular flange with 3 holes for the screws which attach it to the rear cross-piece of the gun. The front face of the cylindrical box is solid, except for a square opening.

*Hexagonal Nut.*—This is threaded internally to fit the rear of the cylindrical box. It is pierced centrally to admit the rear end of the reciprocating spindle.

*Reciprocating Spindle.*—This is made to work in the cylindrical box and is of sufficient length to protrude at both ends. At the front it has a square portion, behind which is a collar that limits its forward movement and acts as a seating for the actuating spring. Beyond this collar the spindle is circular, and of such a diameter as to act as a bearing for the spring. Behind this the spindle is smaller in diameter, and has 14 teeth made to engage with those in the toothed wheel on the right side of the counting mechanism box.

*Actuating Spring.*—This is a spiral spring which fits over the centre portion of the reciprocating spindle, and is enclosed in the cylindrical box. It is always under compression between the collar on the spindle and the hexagonal nut at the rear of the cylindrical box.

*Angle Bracket.*—This is a small steel bracket attached by 2 screws to the right side plate.



### Fitting.

The rounds counter is fitted as follows :—

Eight holes are needed in the rear cross-piece (as per accompanying diagram). These holes should first be correctly marked, so as to ensure the proper engagement of the toothed wheel with the toothed rack of the reciprocating spindle. They should be bored and 7 of them carefully tapped, the eighth being merely a clearance hole. The screws must fit tightly as otherwise it might be necessary to fit spring washers to prevent them from working loose.

Fit into position on the rear cross-piece, by means of 4 screws, the block which carries the counting mechanism box.

Remove the toothed wheel from the shaft on the right side of the counting mechanism box, and fit the box itself on to the block by means of the screws provided.

Fit into position, through the 8th hole, the cylindrical box, and secure it by means of the 3 screws.

Mark bore and tap in the right side plate 2 holes for the screws by which the angle bracket is affixed to the plate, noting that the rear and lower edges of the bracket are flush with the corresponding edges of the side plate extension. With the angle bracket in this position its projecting face is always in contact with the end of the reciprocating spindle, thus avoiding any hammering action.

Put the actuating spring in position on the reciprocating spindle and insert both these parts in the cylindrical box, the toothed portion of the spindle to the rear. Screw on the hexagonal nut.

Turn the shaft on the right side of the counting mechanism box in an anti-clockwise direction with the thumb and fore-finger until a number just registers, taking care that the shaft is not turned any further than is absolutely necessary for this purpose. While the shaft is in this position put on the toothed wheel so that the head of the screw points downward and the last tooth on the wheel is in engagement with the rearmost tooth on the reciprocating spindle. Tighten set screw. To bring the counter to zero, turn the milled nut on the left side of the counting mechanism box in an anti-clockwise direction.

### Action.

The counter is arranged to register during the forward movement of the recoiling portions of the gun. When the gun is fired, the recoiling portions are driven to the rear, carrying with them the angle bracket, which pushes back the reciprocating spindle. The actuating spring inside the cylindrical box is thus compressed and the toothed wheel on the right side of the counting mechanism box is rotated, although the rotation of the wheel during this part of the action does not affect the counting mechanism. Immediately the recoiling portions of the gun go forward, the reciprocating spindle is carried forward by the actuating spring inside the cylindrical box, and the toothed wheel on the right side of the counting mechanism box is rotated in the opposite direction. As a result of this rotation the number already shown on the dial on the counting mechanism box is increased by one.



It will be seen that the counter registers during the *forward* movement of the recoiling portions so that the registration is effected by the gentle action of the actuating spring. If the counter were arranged to register during the *backward* movement of the recoiling portions, the registering mechanism would be subjected to a series of severe jars which would produce unsatisfactory results and speedily derange the mechanism.

### Cautions.

(1) The operating gear of the counter should be oiled periodically but the counting mechanism does not require lubrication and should not be dismantled under any circumstances.

(2) Care should be taken not to bend the reciprocating spindle when the rear cross-piece has been lowered and the recoiling portions are being removed. When withdrawing or replacing these, the spindle should first be pulled backwards to its fullest extent against the actuating spring. This will give sufficient clearance for the right side plate.